G. Smith inv. I. Huldt Sculp.

MEMOIRS
OF THE
Royal Society;
Being a New ABRIDGMENT of the
Philosophical Transactions:

Giving an ACCOUNT of the Undertakings, Studies, and Labours of the LEARNED and INGENIOUS in many considerable Parts of the WORLD; from the first Institution of that ILLUSTRIOUS SOCIETY in the Year 1665, under their Royal Founder King CHARLES II. to the Year of our LORD 1735 inclusive.

Dispos'd under proper GENERAL HEADS, with a Translation of the LATIN TRACTS from their Originals; the Whole regularly abridg'd, the Order of Time observ'd, the Theoretical Parts apply'd to Practical Uses, and an Explanation of the Terms of ART as they occur in the Course of the Work; being a Work of general Use to the Publick, and worthy the Perusal of all MATHEMATICIANS, ARTIFICERS, TRADESMEN, &c. for their Improvement, in various Branches of Business.

By Mr. BADDAM.

Illustrated with COPPER PLATES.

VOL. I.

LONDON:

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M.DCC.XXXVIII.

THE

PREFACE.

IN the enſuing Memoirs, the Reader will find ſuch a collective Body of Learning, that may not improperly be deem'd a Library of Arts and Sciences, fit to grace the Studies of the greateſt Princes; the Philoſophical Tranſactions *of the* Royal Society, *have gain'd ſo great a Reputation among the Learned of foreign Nations, that they are now tranſlating into* French, *by order of his moſt Chriſtian Majeſty, in order to their being printed at the Royal Printing-houſe at the* Louvre: *In this Work I have obſerv'd the Order of Time thoſe Tracts were originally publiſh'd in, by Mr.* Oldenburg, *Secretary of the Society, who firſt ſet them on foot in* 1665, *and continu'd them till the Year* 1679; *and after him Dr.* Hook *continued them under the Title of* Philoſophical Collections: *But afterwards, Dr.* Grew *being appointed to the ſame Office in* 1689, *reſumed the former Title, which was retain'd by his Succeſſor Dr.* Plot, *Dr.* Sloan, *Dr.* Jurin, *and others, and continues ſo to this Day. And here it may not be amiſs to give ſome Account of the Riſe and Foundation of the ſaid Royal Society, and thereby gratify the Curioſity of our Subſcribers, which is as follows.*

This illuſtrious Society had its Original in an Aſſembly of ingenious Men, who, before the Reſtauration, *met weekly in* Wadham *College,* Oxford, *at the Lodgings of Dr.* Wilkins; *afterwards from about the Year* 1658, *(many of them living in* London*) held Meetings at* Greſham *College; till they were at length taken notice of by the King, who was pleas'd to grant them an ample Charter, dated the* 22d *of* April, 1663; *whereby they were erected into a Corporation, conſiſting of a Preſident, Council, and Fellows, for promoting the Knowledge of natural Things, and uſeful Experiments: Their Deſign was to make faithful Records of all the Works of Nature or Art, which came within their Cogniſance; ſo that the preſent as well as after Ages may be enabled to put a Mark upon the Errors which have been ſtrengthened by long Preſcription; to reſtore Truths*

that have been long neglected; to push those already known to more various Uses; and thereby make the Way more passable to what remains undiscover'd.

For this End, that learned Body hath made a great Number of Experiments and Observations, in most of the Works of Nature, viz. *Eclipses, Comets, Meteors, Mines, Plants, Earthquakes, Inundations, Springs, Damps, subterraneous Fires, Tides, Currents, Magnetism,* &c.

They have also transmitted to us many short and concise Histories of Nature, Arts, Manufactures, useful Engines, and notable Contrivances; all which highly redound to their Honour, and are of especial Use and Service to the Publick: They likewise have improv'd Naval, Civil, and Military Architecture; advanc'd the Security and Perfection of Navigation; improv'd Agriculture; and put not only this Kingdom, but Ireland *and the* Plantations, *upon Improvements in planting.*

They have register'd Experiments, Histories, Relations, Observations, &c. *and reduc'd them into one common Stock; which have from time to time been publish'd (especially those of the most immediate Use) under the Title of the* Philosophical Transactions, *as abovementioned; and laid the rest up in publick Registers, to be nakedly handed down to Posterity, as a solid Ground-work for future Systems.*

They have a Library adapted to their Institution, towards which the late Earl Marshal generously contributed the Norfolcian *Library; and a* Musæum, *or Repository of natural and artificial Rarities, given them by* Daniel Colwal, *Esq; which has been since considerably augmented by the Donations of many others.*

Furthermore, Dr. Sprat, *in his History of the* Royal Society, *printed in the Year* 1667; *concludes his Treatise with a Catalogue of the worthy Members that compos'd that august Body, amounting to near* 200; *whereof his Majesty King* Charles *the* II. *was Founder and Patron: Among the Fellows were three of the greatest Princes of* Europe, *viz. his Royal Highness the Duke of* York; *his Highness Prince* Rupert, *Count* Palatine *of the* Rhine; *and his Highness* Ferdinand Albert, *Duke of* Brunswick *and Lunenburg; then the two Archbishops, and four Bishops; of Dukes, Marquisses, Earls, Viscounts, and Barons,* English *and* Scotish, 29; *of Knights* 25; *of Doctors and Batchelors of Divinity* 74; *of Esquires, and other Gentlemen and Merchants* 64; *of Foreigners* 16.

After the Enumeration of which, he recommended this Undertaking to the English *Nation; as the bravest People, and the most generous Design; which at once regards the discovering of new Secrets, and the purifying and repairing all the profitable things of Antiquity; he farther represents, that if this Design thus so well establish'd, should at any time fail, for want of Patronage and Revenue, the World would not only be frustrated of their present Expectations, but have just Reason to despair of any future Labours towards the Encrease of practical and useful Knowledge: But he hopes and presages, that the* English *Nation will lay hold on this Opportunity, to deserve the Applause of Mankind for having encouraged and supported a Work, which instead of barren Terms and Notions, is able to impart to us the Uses of all the Creatures; and to enrich us with all the Benefits of real Knowledge, true Honour, great Plenty, and solid Delight.*

Thus having given a short and succinct Narrative of the Royal Society *and their Transactions; I thence proceed to shew the Method I have taken, which will be observed throughout the Course of this Performance.*

I. *I shall constantly select the best Pieces as they arise in the order of Time they were publish'd in, which will consist of choice Theories and Discourses, such as have already stood the Test of the Learned; such are new Discoveries, in the animal, vegetable, and mineral Kingdoms; curious Anatomical Remarks, Observations and Improvements, wherein the Humane and Comparative are consider'd as Solid and Fluid, and apply'd to Physick, being a Branch thereof; Natural History; some Queries and Directions given by the honourable Mr.* Boyle *and others, to Persons travelling abroad, either by Sea or Land, to make proper Remarks and Observations on all Occasions; as the Phænomena of Meteors of various kinds, extraordinary Tides, Rivers, Lakes, Springs, Water-Spouts, Currents, Mountains, Vulcano's and Earthquakes; Minerals, Plants, Birds, Beasts, Fishes, Insects,* &c. *The Result whereof was, Answers to those Queries, wherein are inserted great Variety of beautiful Descriptions both of Art and Nature.*

In Philosophy are many beautiful Experiments, which were contrived to demonstrate the Truth of former Theories, and several Instruments devised for that Purpose: In Physick many extraordinary Cases have occurr'd, the Reasonings thereon, and Applications made use of: In Chymistry are shewn many notable Experiments, as Processes, Combinations, Resuscitations, &c.

of

of eſpecial Uſe: In Mathematicks, Mechanicks, &c. *are many choice Propoſitions, Demonſtrations, Conſtructions, Menſurations, Deſcriptions, Inventions, Improvements, Inſtruments, Laws, Ratio's,* &c. *which are univerſally acknowledg'd to be the moſt ſatisfactory Accounts of the Proceedings both of Nature and Art, wherein ſome of her greateſt Depths are fathom'd, and a Foundation laid for Poſterity to build an infinite Superſtructure.*

II. *I ſhall in the Proſecution of this Work always keep cloſe to the true Meaning of the ſeveral Authors, whoſe Names will be conſtantly mentioned, and the Number of the Page where taken from in the Originals, omiting the epiſtolary Forms and Complements that paſſed between ſeveral of the Members of the* Royal Society *both at home and abroad, as being merely Matters of Ceremony: The* Latin *Tracts will be tranſlated in their proper Places, and the genuine Senſe of their Authors preſerv'd, in a plain and eaſy Stile. I ſhall alſo make proper Applications to ſuch Theories or Experiments where requiſite, as will fit them for practical Uſes, and explain the technical Terms of Art: The tedious Journals of the Weather will be omitted, on Account of the Uncertainty of building any rational Syſtem on ſuch a Foundation, frequently liable to Errors; but for the Satisfaction of ſuch Gentlemen that are poſſeſs'd of proper Apparatus*'s, *I ſhall exhibit a Journal of Obſervations for a Month, and lay down proper Remarks ſufficient to ſhew how ſuch Journals ought to be kept, which will be entertaining to thoſe that have Leiſure to attend, and Curioſity to remark the Phænomena thereof: And as to the Extracts that are inſerted under the Article of Books and Papers of leſs general Uſe omitted, I propoſe to take no Notice of them, unleſs there ſhould appear therein any Thing very material to deſerve it.*

MEMOIRS
OF THE
ROYAL SOCIETY;

Being a new ABRIDGMENT of the

Philosophical Transactions.

The Motion of the Comet Anno *1664. predicted by M.* Auzout. Philosophical Transactions N° 1. p. 3.

THE motion of comets was hitherto thought so irregular as not to be reducible to any laws, and men had always contented themselves to observe exactly the places through which they passed, and where they ceased to appear; till M. *Auzout* first attempted to foretel the line of the motion of the comet *Anno* 1664; exhibiting an ephemerides, wherein he determines for every day its place in the heavens, the hour of its coming to the meridian and that of its setting, until its too great distance, or its approach to the sun should hide it from our eyes. This ephemerides is founded on the supposition of its moving justly enough in the plane of a great circle, inclined to the equinoctial about 30°, and to the ecliptic about 49° or 49°½, cutting the equator at about 45°½, and the ecliptic at 28° of *Aries*, or a little more. Then M. *Auzout* proceeds to show how the motion of this comet is to be traced on the globe, and to calculate the several places of its appearance in the heavens, and in particular he finds by his calculations what the least distance of the comet from the earth should be, when it is in opposition to the sun; a circumstance that may serve, as he thinks to decide the grand question concerning the *Motion of the Earth*.

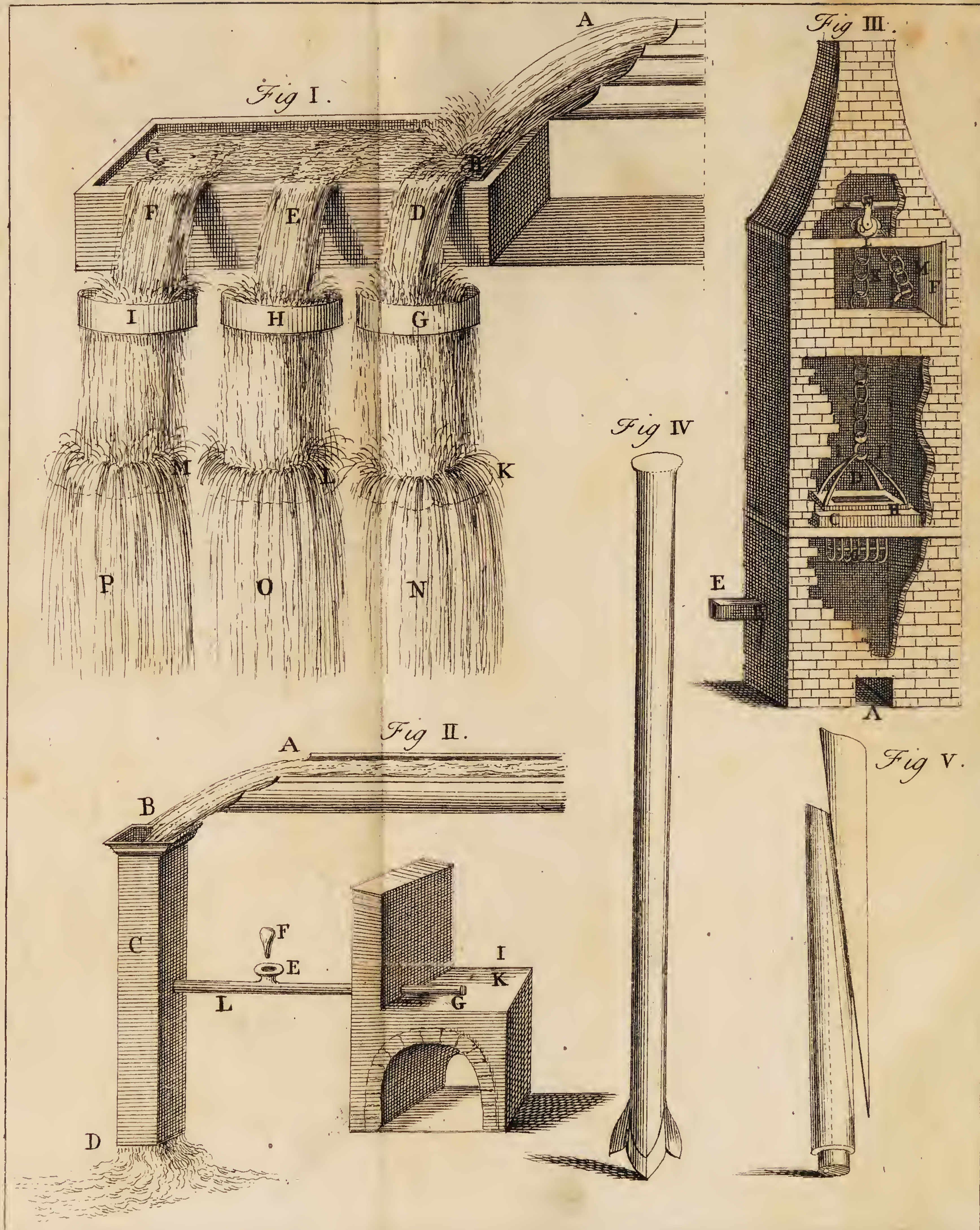
Of the New American Whale-Fiſhing *about* Bermudas, *by a Seaman.* Phil. Tranſ. N° 1. p. 11.

THOUGH many attempts of maſtering the whales of theſe ſeas had been unſucceſsful, by reaſon of their extraordinary fierceneſs and ſwiftneſs; yet it had been lately undertaken, and fit perſons being out at ſea ſeventeen times, and faſtening their weapons a dozen times, killed two old female whales and three cubs. The length of one of the old ones from the head to the extremity of the tail was 88 foot; its tail 23 foot broad, the ſwimming fin 26 foot long, and the gills three foot long, with great bends underneath from the noſe to the navel; on her after-part a fin on the back, and the inſide inlaid with fat like the caul of a hog. The other old one was about 60 foot long. Of the cubs, one was 33, the other two, much about 25 or 26 foot long. Their ſhape was very ſharp behind, like the ridge of a houſe; the head pretty bluff, and full of bumps on both ſides, the back perfectly black, and the belly white. Their ſwiftneſs and force are ſurprizing, one of them that had been ſtruck towed the boat after him for ſeven or eight leagues in three quarters of an hour. When wounded they make a hideous roaring, at which all the whales within hearing flock to the place, yet without ſtriking or doing any harm. Theſe Whales are ſuppoſed to reſemble that ſpecies called *Jubartes*; they are without teeth, and longer than the *Greenland* whales, but not ſo thick. Their feeding on graſs, growing at the bottom of the ſea, appeared by cutting up the great bag or maw, wherein was found about two or three hogſheads of a greeniſh graſſy matter. The largeſt ſort of theſe whales might afford ſeven or eight tuns of oil. The cubs yield little, and that a kind of jelly only. The oil of the old ones candies like pork's greaſe, yet burns well. The oil of the blubber is as clear and fair as whey; that boil'd out of the lean interlarded, hardens like tallow, ſpattering in the burning, and that made of the caul reſembles hog's greaſe. One may run his hand into this oil when boiling without ſcalding, it being endowed with a healing quality in curing green wounds, lameneſs, &c. by anointing the part affected. The time of catching them is from the beginning of *March* to the end of *May*, after which they diſappear and retire into the weedy beds of the gulph of *Florida*, it being obſerved that they have ſtore of clams and barnacles on their fins and tails, on which the rock weed grows about ſeven inches long.

Dr.

pag. 3

PLATE. I.



Hulett Sculp

Dr. Walter Pope's *Account of the* Quickſilver Mines *in* Friuli. Phil. Tranſ. N° 2. p. 21.

THE Mines of mercury in *Friuli*, a *Venetian* territory, are diſtant about a day's journey and a half from *Goritia* northwards, at a place called *Idria*, ſituated in a valley of the *Julian Alps*. They have been theſe 160 years in the poſſeſſion of the emperor, the inhabitants ſpeak the *Sclavonian* tongue. In *Auguſt*, when I was there, the valley and the mountains too, out of which the mercury was dug, were as verdant, as if it had been the middle of ſpring, owing, as is ſuppoſed, to the moiſtneſs of the mercury. That mine, into which we enter'd, the beſt and greateſt of them all, was dedicated to St. *Barbara*, as all the Mines are to ſome ſaint or other; its depth was 125 paces, every pace exceeding five of our feet. The Mineral is dug with pick-axes, according to the courſe of the veins; 'tis generally hard as a ſtone, but heavier, of a liver colour, or that of *Crocus Metallorum*. There is alſo ſome ſoft earth, in which the mercury is ſeen in little particles. There are ſometimes found in the mines round ſtones like flints, of ſeveral bigneſſes, reſembling thoſe globes of hair taken out of the bellies of oxen. There are alſo ſeveral marcaſites and ſtones, which ſeem to contain ſpecks of gold, but on trial they find none. Some of theſe round ſtones are very ponderous and impregnated with mercury; others light, and with little or none.

The manner of getting the mercury out of theſe Mines is this: The earth taken out of the mine in buckets is put into a ſieve made of wires, and waſhed in running water as long as any thing will paſs through it, that which paſſes is reſerved in the hole G, Fig. 1. and taken up again by the ſecond man, and ſo on to about ten or twelve ſieves proportionably leſs. The earth that cannot paſs is pounded, and the ſame operation repeated. The fine ſmall earth that remains, and out of which no more mercury can be waſhed, is put into iron retorts luted to receivers, into which the mercury is forced by fire. The *Caput Mortuum* is pounded, and the operation renewed while any mercury can be got, and this is called the *ordinary mercury*, that obtained by waſhing or found in the Mines being denominated *virgin mercury* and eſteemed the beſt, for upon making an amalgama of gold and virgin mercury and putting it to the fire, it will carry all the gold with it, which cannot be effected by common mercury.

To illuſtrate this ſee Plate I. Fig. 1. where A is the water, B C a veſſel into which it runs, D E F are ſtreams perpetually

running from that veſſel into G H I three ſieves, the diſtance of whoſe wires at bottom leſſen proportionably; K L M the places where the earth paſſing thro' the ſieves G H I is retained; whence it is taken up by the ſecond man; N O P the waſte water.

The labourers in theſe mines become paralytic and die hectic, ſome later and ſome ſooner.

We ſaw a man who had not been half a year in the mines, ſo full of mercury, that putting a piece of braſs in his mouth, or rubbing it in his fingers, it immediately became as white as if mercury had been rubbed on it.

Theſe mines formerly coſt the emperor 70,000 or 80,000 florins yearly, and yielded leſs mercury than now, though the charges are only 28,000 florins. They produced in the three following years,

Anno 1661.		*l.*
	Ordinary Mercury	198481.
	Virgin Mercury	6194.
	In all	204675.
1662.		*l.*
	Ordinary Mercury	225066.
	Virgin Mercury	9612.
	In all	234678.
1663.		*l.*
	Ordinary Mercury	244119.
	Virgin Mercury	11862.
	In all	255981.

The Blowing *of* Fire *by the Fall of Water*, *by the ſame*. Phil. Tranſ. N° 2. p. 25.

IN the braſs works of *Tivoli* near *Rome*, the water blows the Fire, not by moving bellows, but by affording the wind. See Fig. 2. where A is the river; B the fall of it; C the tub into which it falls; L G a pipe; G the orifice of the pipe, or noſe of the bellows; G K the hearth; E a hole in the pipe; F a ſtopper to the hole; D a place under ground, by which the water runs away. Upon ſtopping the hole E, there is a perpetual ſtrong wind iſſuing forth at G.

Of

Of the way of killing Rattle Snakes, *by Captain* Silas Taylor. Phil. Transſ. N° 3. p. 43.

THE wild-penny-royal, or dittany of *Virginia*, grows ſtraight up about one foot high, with the leaves like penny-royal, with little blue tufts at the joining of the branches to the plant, the colour of the leaves being a reddiſh green; but the water diſtilled, of the colour of brandy, of a fair yellow: The leaves of it bruiſed are very hot and biting upon the tongue. Of theſe leaves ſo bruiſed were taken ſome, which tied in the cleft of a long ſtick were held to the noſe of the rattle-ſnake, who by turning and wriggling laboured as much as ſhe could to avoid it; but ſhe was killed with it in leſs than half an hour's time, and as was ſuppoſed by its ſcent. This was done in *July*, when theſe creatures are reputed to be in the greateſt vigour for their poiſon. It is alſo remarkable, that in thoſe places where the wild-penny-royal grows, no rattle-ſnakes are obſerved to come.

Damps in Mines, *by Sir* Robt. Moray. Phil. Tranſ. N° 3. p. 44.

IN a coal-pit belonging to the lord *Sinclair* in *Scotland*, where the coal is about 18 or 20 foot thick, and anciently waſted to a great depth, the colliers ſome weeks ago, having wrought as deep as they could, and being to remove into new rooms, as they call them, did, by taking off, as they retired, part of the coal that was left as pillars to ſupport the roof and earth over it, ſo much weaken them, that within a ſhort ſpace, after they were gone out of the pit, the pillars falling, the earth above them filled up the whole ſpace, where the colliers had lately wrought, with its ruins. The colliers hereby being out of work, ſome of them adventur'd to work upon the old remains of walls ſo near the old waſtes, that ſtriking thro' the ſlender partitions of the coal-wall, that ſeparated between them and the place where they uſed to work, they quickly perceiv'd their error; and fearing to be ſtifled by the foul air they knew poſſeſſed theſe old waſtes, in regard not only of the damps, which ſuch waſtes do uſually afford, but becauſe there had been, for many years, a fire in thoſe waſtes, that filled them with ſtifling fumes and vapours, retired immediatly, and ſaved themſelves from the eruptions of the damp. But next day 7 or 8 of them no ſooner came ſo far down the ſtairs, that led them to the place where they had been the day before, as they intended, but upon their ſtepping into the place where the air was infected, they fell down dead as if they had been ſhot. And there being amongſt them one, whoſe wife being informed he was ſtifled in that

that place, ſhe went down ſo far without inconvenience, that, ſeeing her husband near her, ſhe ventur'd to go to him; but being ſuffocated by the damp, as ſoon as ſhe came near him, ſhe fell down dead by him.

A Mineral *at* Liege *yielding* Brimſtone *and* Vitriol, *by the ſame.* Phil. Tranſ. N° 3. p. 45.

THE mineral out of which brimſtone and vitriol are extracted, is one and the ſame; and not much unlike lead ore.

To make brimſtone, they break the ſtone or ore into ſmall pieces, which are put into crucibles, made of earth five foot long, ſquare and pyramidical; the entry is near a foot ſquare. The crucibles are laid ſloping, eight undermoſt and ſeven above them, and as it were betwixt them, that the fire may reach them all, each having its particular furnace or oven. The brimſtone being diſſolved, drops out at the ſmall end of the crucible, and falls into a leaden trough, common to all the crucibles, thro' which there runs a continual rivulet of cold water, conveyed thither by pipes, for cooling the diſſolved ſulphur, which is ordinarily four hours in melting. After this the aſhes are drawn out, laid in a heap, and covered with other elixed or drained aſhes to keep them warm.

To make copperas or vitriol. They take a quantity of the ſaid aſhes, and throwing them into a ſquare planked pit in the earth, about four foot deep and eight foot ſquare; they cover the ſame with ordinary water, and let it lie 24 hours, or till an egg will ſwim on the liquor, which is a ſign that it is ſtrong enough. When they would boil this, it is conveyed through pipes into kettles, adding to it half as much mother water, which is the water remaining after boiling of the hardened copperas. The kettles are of lead 4½ foot high, 6 foot long, and 3 foot broad, ſtanding on thick iron grates. In theſe the liquor is boiled with a ſtrong coal fire, 24 hours or more, according to the ſtrength or weakneſs of the lee or water. When it is come to a juſt conſiſtence, the fire is taken away, and the boiled liquor ſuffered to cool a little, and then it is tapped out of the ſaid kettles through holes beneath in their ſides, and conveyed through wooden gutters into ſeveral receptacles, three foot deep, and four foot long, where it remains 14 or 15 days, or till the copperas ſeparate itſelf from the water, and become icy and hard.

Extraordinary Tides *in the West-Isles of* Scotland, *by the same.* Phil. Transf. N° 4. p. 53.

IN that tract of isles on the west of *Scotland*, called by the inhabitants the *long Island*, as being about 100 miles long from north to south; there is an island called *Berneray*, three miles long and more than a mile broad, the length running from east to west, as the firth or streight lies. At the east end of this island I observed a very strange reciprocation of the flux and reflux of the sea, and I heard of another no less remarkable.

Upon the west side of the *long Island*, the tides which came from the south west run along the coast northward; so that during the ordinary course of the tides, the flood runs east in the firth where *Berneray* lies, and the ebb west. And thus the sea ebbs and flows regularly for about four days before the full moon and change, and as long after. But for four days before the quarter moons and as long after, there is constantly a great and singular variation. For then, (a southerly moon making there full sea) the course of the tide being eastward when it begins to flow, which is about 9 ½ of the clock, not only continues so till about 3 ½ in the afternoon, when it is high water, but after it begins to ebb, the current runs on still eastward, during the whole ebb, so that it runs eastward 12 hours together, that is, all day long from 9 ½ in the morning, till about 9 ½ at night. But then when the night tide begins to flow, the current turns and runs westward all night, during both flood and ebb, for about 12 hours more, as it did eastward the day before. And thus the reciprocations continue, one flood and ebb running 12 hours eastward, and the other 12 hours westward, till four days before the new and full moon, and then they resume their ordinary regular course as before, running east during the six hours of flood, and west during the six of ebb.

The other irregularity in the tides is no less extraordinary than the above-mentioned. That whereas between the vernal and autumnal equinoxes, that is, for six months together; the course of irregular tides about the quarter moons is to run all day, that is 12 hours, as from about 9 ½ to 9 ½, 10 ½ to 10 ½, *&c.* eastward, and all night, that is 12 hours more, westward; during the other six months, from the autumnal to the vernal equinox, the current runs all day westward, and all night eastward.

Adits

Adits *and* Mines *wrought at* Liege *without* Air Shafts, *by the same.* Phil. Tranſ. N° 5. p. 79.

AT the entry of the adit, there is a ſtructure of brick like a chimney, about 28 or 30 foot high; at the bottom two oppoſite ſides are, or may be, 5 ½ foot broad, and the other two, 5 foot; the wall 1 ½ brick thick. At the lower part of it, is an aperture about 9 or 10 inches ſquare, for taking out the aſhes, which when done, this aſh-hole is immediately ſtopt ſo cloſe, as to exclude the leaſt air. About 3 foot or more above ground, there is on that ſide next the adit or pit, a ſquare hole of 8 or 9 inches, for admitting air to make the fire burn; into this hole is fixed a ſquare tube or pipe of wood, whoſe joints and chinks are ſo ſtopt with parchment paſted or glued upon them, that the air has no admittance but by the end; and this pipe is ſtill lengthened, as the adit advances, by fitting new pipes into one another, and carefully ſtopping the joints and chinks as above. So the tube being ſtill carried on to the place where freſh air is neceſſary, while it is drawn by the fire through the tube, there will be a conſtant ſupply of it, and by its motion it will carry away with it all noxious vapours, and men will breathe there as ſafely as in the open air, and not only candles but fire will burn, when upon occaſion there is uſe for it in breaking the rock.

That there may be a conſtant ſupply of freſh air, the fire muſt be always kept burning in the chimney; for which purpoſe, there muſt be two iron grates or chimneys, that upon any accident, the other may be ready to be put in its place; the coal being firſt well kindled in it: But when the fire is near ſpent, the grate being haled up to the door, is to be ſupplied with freſh fuel.

The higher the ſhaft of the chimney is, the fire draws the air the better. And this invention may be uſed in perpendicular pits or ſhafts, when there is want of freſh air at the bottom, or in caſe of unwholeſome fumes or vapours.

The whole contrivance may be underſtood by the annexed figure. Plate I. Fig. 3.

A the hole for taking out the aſhes; B the ſquare hole, into which the tube or pipe for conveying the air is to be fixt; C the border or ledge of brick or iron, on which the iron grate or cradle, that holds the burning coals is to reſt; the one being exactly fitted for the other; D the hole where the cradle is ſet; E the wooden tube, through which the air is conveyed towards the cradle; F the door, by which the grate or cradle is let in, which is to be ſet 8 or 10 foot higher than the hole D; and the ſhutter

ſhutter made of iron or wood that will not ſhrink, that it may ſhut very cloſe; G the grate or cradle, which is narrower below than above, that the aſhes may the more eaſily fall, and the air excite the fire, the bottom and ſides being barred; H the border or ledge of the cradle that reſts on the ledge C; I four chains of iron faſtened to the four corners of the cradle, for taking it up and letting it down; K the chain of iron, to which the other chains are faſtened; L the pulley of iron or braſs, through which the chain paſſes; M a hook, on which the end of the chain is faſtened by a ring, the hook being fixed in the ſide of the door; N a bar of iron in the walls, to which the pulley is faſtened.

M. du Son's *Method of* Breaking Rocks. Phil. Tranſ. N° 5. p. 82.

THE Invention of breaking hard rocks with eaſe and diſpatch is uſeful on ſeveral occaſions; as in cutting of adits, or paſſages through them, for draining water out of mines of lead, tin, or any other kind of minerals whatever.

The tool employed in this operation is of iron well ſteeled at the end, ſee Plate I. Fig. 4. about 20 or 22 inches long, and 2 ½ in diameter at the ſteeled end, the reſt being ſomewhat more ſlender. The ſhape of the ſteeled end muſt be ſuch as to make it the fitteſt to pierce the rock, and the harder the rock is, its angles muſt be the more obtuſe. This inſtrument is to be ſtruck upon by a hammer. After every blow its point is to be ſhifted, that its angles may ſtrike on a new place. And thus the work be continued till the hole become 18 or 20 inches deep, the deeper the better. To this hole a double wedge is to be exactly fitted, ſee Fig. V. each piece being 12 or 13 inches long, and ſo made, that joined together they may form a cylinder, cut diagonally. The two flat ſides that are contiguous are to be greaſed or oiled, to ſlip the more eaſily the one upon the other. One of the pieces which is to be uppermoſt, muſt be cut round into a hollow creaſe at the great end, for faſtening to it with a thread a cartridge of gun-powder, about half a pound or more as there is occaſion, and that end muſt be pared in proportion to the thickneſs of the paſtboard, to make it even with the reſt of the wedge. This wedge muſt have a hole drilled through its length to be filled with priming powder for firing that in the cartridge, and thruſt into the hole with the round ſide uppermoſt, and afterwards the other wedge be driven to its due poſition, obſerving that they both fit the hole in the rock exactly. Then on the end of the lower wedge, which is to be about an inch longer than that of the upper, priming powder is to be laid, and a piece of

burning match or thread dipt in brimſtone faſtened to it, that the operator may have time enough to retire before the powder be fired, which, when done will rend the Rock to pieces.

Inquiries concerning Agriculture. Phil. Tranſ. N° 5. p. 91.

THE Royal Society in proſecuting the improvements of natural knowledge had divided themſelves into divers committees, according to the ſeveral inclinations and ſtudies of their members. That for Agriculture, began their work with drawing up certain heads of inquiries for procuring a faithful and ſolid information of what is already known and practiſed in that branch of knowledge, and for giving hints of what further improvements may be made therein.

I. *For Arable Ground.*

1. The ſeveral kinds of ſoils in *England*, being ſuppoſed to be either ſandy, gravelly, ſtony, clayey, chalky, light-mould, heathy, marſhy, boggy, fenny, or cold weeping ground. What is the ſoil of each country, and how prepared for arable?

2. What peculiar preparations each ſoil undergoes for each kind of grain; what kind of manure, when, how, and in what quantity laid on?

3. At what ſeaſons and how often ploughed, and the kinds of ploughs uſed for ſeveral ſorts of ground?

4. How long the ſeveral grounds lie fallow?

5. How, and for what productions heathy grounds may be improved?

6. What ground has marle, how deep it lies, and what the depth of the marle itſelf? What its colour, on what grounds uſed? What time of the year to be laid on, how many loads to an acre? What grain marled land will bear, and how many years together, how ſuch marled land is to be uſed afterwards? &c.

7. The kinds of grain and ſeed uſual in *England*, being wheat, miſcelane, rye, barley, oats, peaſe, beans, vetches, buck-wheat, hemp, flax, rape; what ſorts of theſe are ſown in each county, and how prepared? Whether by ſteeping, and in what kind of liquor? Or by mixing it, and with what?

8. There being ſeveral ſorts of wheat, oats, barley, peaſe, beans, &c. Which of theſe grow in each county, and in what ſoil, which of them thrive beſt, and whether each of them require a peculiar tillage, and how they differ in goodneſs?

9. What are the particulars obſervable in the choice of ſeed-corn, and all kinds of grain, and what kinds of grain are moſt proper to ſucceed each other?

10. What

10. What quantity of each kind is ſown on the ſtatute-acre, and in what ſeaſon of the moon and year?

11. With what inſtruments they harrow, clod, and rowl, and at what ſeaſons?

12. How much an acre of good corn generally yields, in very good, indifferent, and in the worſt years?

13. What are the cauſes and remedies of mildew, blaſting, and ſmut, being ſome of the common diſeaſes of corn in its growth?

14. How weeds, worms, flies, birds, mice, moles, *&c.* are prevented?

15. Upon what occaſions young corn is cut or fed in the blade, and what are the benefits thereof?

16. What are the ſeaſons and ways of reaping and ordering each ſort of grain, before it be carried off the ground?

17. What are the ſeveral ways of preſerving grain in the ſtraw, within and without doors, from all annoyance; as mice, heating, rain? *&c.*

18. What are the ſeveral ways of ſeparating the ſeveral ſorts of grain from the ſtraw, and of dreſſing them?

19. What are the ways of preſerving any ſtores of grain from the annoyances they are obnoxious to?

II. *For Meadows.*

1. How the above mentioned ſorts of ſoil are prepared, when they are uſed for paſture or meadow?

2. How the common annoyances of theſe paſture or meadow-grounds, as weeds, moſs, ſour-graſs, heath, fern, buſhes, briars, brambles, broom, ruſhes, ſedges, gorſe, or fuzzes, are prevented.

3. What are the beſt ways of draining marſhes, bogs, fens? *&c.*

4. What are the ſeveral kinds of graſs, and which the beſt?

5. What are the chief circumſtances obſervable in the cutting of graſs; and what in the making and preſerving of hay?

6. What kind of graſs is fitteſt to be preſerved for winter feeding; and what graſs is beſt for ſheep, cows, oxen, horſes, goats? *&c.*

M. Vilette's *burning* Concave. Phil. Tranſ. N° *6.* p. *96.*

THE figure of this concave is round, and about 30 inches in diameter, its focus or burning point about 3 foot diſtant from the center of the glaſs, and about ½ a Louis d'or in magnitude. One may paſs his hand nimbly through it; for if it be held there a ſecond of time, there is danger of getting much hurt. Green wood takes fire in it in an inſtant. A ſmall piece of pot

iron was melted in 40 ſeconds, a ſilver piece of 15 pence was pierced in 24″. A great nail was melted in 30″. The end of a ſword-blade of *Olinde* was burned in 43″, A braſs counter was pierced in 6″. A piece of red copper was melted in 42″. A piece of a chamber quarry ſtone was vitrified in 45″. Steel of which watch ſprings are made was melted in 9″. A mineral ſtone, ſuch as is uſed in harquebuſſes *a rouët* was calcined and vitrified in a ſecond, and a piece of mortar in 52″. In ſhort, there is hardly any body, which this fire is not capable of either melting or vitrifying. As the bigneſs of the focus is but ſmall, ſo none but little pieces can be expoſed to it, for a greater bulk would require much time to produce its effect.

Milk *found in Veins inſtead of Blood*; *and* Graſs *in the Wind-pipes of ſome Animals.* Phil. Tranſ. N° 6. p. 100, *&c.*

A Curious perſon, ſome time ago, wrote from *Paris*, that upon opening a man's vein, they found milk inſtead of blood. This is alſo confirmed by Dr. *Lower*, who ſays, that a maid, after eating a good breakfaſt, about ſeven in the morning, was let blood in her foot about eleven the ſame day; the firſt blood was received in a porringer, and in a little time it turned white; the laſt blood was received in a ſaucer, which became white immediately, like the white of a cuſtard; within five or ſix hours after, the Doctor ſaw both; and that in the porringer was half blood, half chyle, ſwimming upon it like a ſerum, as white as milk; and that in the ſaucer all chyle, without the leaſt appearance of a drop of blood; and when he heated them ſeperately over a gentle fire, they both hardened, like the white of an egg, or the ſerum of blood when heated, but much whiter. This maid was then in good health, and of a very florid clear complexion, and only let blood becaſe ſhe never had her courſes.

To theſe obſervations Dr. *Beal* adds a phænomenon of ſome reſemblance to them, which he had above 20 years ago from *Thomas Day* an apothecary at *Cambridge*; that himſelf let a man blood in the arm, which was as white as milk; as it run out of his arm it had a little dilute redneſs, but as it fell into the veſſel, it was preſently white, and continued like drops of milk on the pavement. Dr. *Eade*'s conjecture, a phyſician at *Cambridge*, was, that the patient had fed much on fiſh; affirming withal, that he would have ſoon become leprous, if it had not been prevented by phyſick.

The other particular mentioned in the title, was communicated by Mr. *Boyle*; Dr. *Clarke* and Dr. *Lower* giving him an account of

of a very odd kind of obſervation: One of them aſſuring him, that he had ſeveral times found in the lungs of ſheep, conſiderable quantities of graſs in the very branches of the *Aſpera Arteria* or wind-pipe: And the other inform'd him, that a few weeks ſince, he and a couple of phyſicians were invited to look upon an ox, that had almoſt for two or three days continually held his neck upright, and died of a diſeaſe the owner could not gueſs at; whereupon, opening the throat, they found the very trunk of the *Aſpera Arteria* ſtuffed with graſs, as if thruſt into it by force; which may make one wonder how ſuch a quantity of graſs could get in there; and how being there, ſuch an animal could live with it ſo long.

Petrification, *by Mr.* Boyle. Phil. Tranſ. N° 6. p. 101.

A Gentleman informed him he lit on a place in theſe parts of *England*, *viz.* about *Oxford*, where, though there be no petrifying ſpring, wood is turned into ſtone in the ſandy earth itſelf, in a better manner, than by any petrifying water he ever ſaw.

Upon making experiments on this wood, he found it very hard and fixed. Mr. *Boyle* mentions alſo a certain ſtone, thought to be a petrified bone, with the marrow taken out, being in ſhape like it; but with a proper Menſtruum, he found that he could eaſily diſſolve it, like other ſoft ſtones; and thinks it may poſſibly anſwer the ſame medicinal intentions with *Oſteocolla*, or the glew-bone.

Of the Nature of a certain Stone *found in the Head of a Serpent in the* Indies. Phil. Tranſ. N° 6. p. 102.

SIR *Philiberto Vernatti* ſent from *Java* to Sir *Robert Moray*, for the repoſitory of the Royal Society, a certain ſtone, which he affirmed to be found in the head of a ſnake, which laid on a wound, made by any venomous creature, ſticks to it, and draws out all the poiſon; and then, being put into milk, it is ſaid, to diſcharge its poiſon therein, and turns it blue; in which manner it muſt be uſed till the wound be cleanſed.

This relation has been ſince confirmed by M. *Thevenot* in his travels; who ſays, that in the *Eaſt-Indies*, and in the kingdom of *Quamſy* in *China*, there is found a ſtone in the head of a certain ſerpent, which they call by a name ſignifying a hairy ſerpent, which heals its bite, that elſe would be mortal in 24 hours. This ſtone is round, white in the middle, and about the edges blue or greeniſh; being applied to the wound,

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it adheres to it, and falls not off, till it has extracted the poiſon; then they waſh it in milk, wherein it is left a while, till it returns to its natural condition. If it be put the ſecond time on the wound, and ſtick to it, it is a ſign, all the poiſon was not extracted by the firſt application; but if it ſtick not, it is certain that all the poiſon is drawn out.

Of the Method of making Salt-petre *in the* Mogul's *Dominions, by M.* Thevenot. Phil. Tranſ. N° 6. p. 103.

SALTPETRE is found in many places of the *Eaſt-Indies*, but chiefly about *Agra*, and in villages, formerly very populous, but now deſerted. It is extracted out of three ſorts of earth, black, yellow, and white: The beſt is that taken from the black, as being free from common ſalt. They work it in this manner: Firſt they make two pits, flat at bottom, like thoſe wherein common ſalt is made; one of them which has more compaſs than the other, they fill with earth, on which they let water run, and treading it with their feet, reduce it to the conſiſtence of a pap, and ſo let it ſtand for two days, that the water may extract all the ſalt that is in the earth: Then this water runs into another pit in which it cryſtallizes into ſalt-petre. They boil it once or twice in a cauldron, according as they would have it whiter and purer; while over the fire, they ſcum it continually, and fill it out into earthen pots that hold each 25 or 30 pounds, and theſe they expoſe to clear nights; and if any impurity remain, it will fall to the bottom; afterwards they break the pots and dry the ſalt in the ſun.

Changes likely to be diſcovered in the Moon, by M. Auzout, Phil. Tranſ. N° 7. p. 120.

I Sometimes think that the earth muſt appear to the ſuppoſed inhabitants of the moon, with a different face in the ſeveral ſeaſons of the year; and to have another appearance in winter, when ſcarcely any thing is green on a great part of the earth; when there are countries all covered over with ſnow; others with water, others all obſcured with clouds, and that for many weeks together; another in ſpring, when the foreſts and fields are green; another in ſummer, when the whole are yellow, *&c.* Methinks ſuch changes are conſiderable enough to be obſerved, by reaſon of the different reflections of light, ſince ſo many differences of light are ſeen in the moon. We have rivers conſiderable enough to be ſeen, and they enter far enough into the land, and have breadth ſufficient to be obſerved. There are fluxes in certain places

places that reach into large countries, sufficient to make there some apparent change; and in some of our seas, there float sometimes such bulky masses of ice, as are far greater than the objects we are assured we can see in the moon. Again we cut down whole forests and drain marshes, of an extent large enough to cause a notable alteration; and men have made such works as have produced changes great enough to be perceived. In many places are vulcano's, that seem big enough to be distinguished, especially in the shadow. And when forests and towns of great extent are on fire, it can hardly be doubted but these luminous objects would appear, either in an eclipse of the earth, or when such parts of the earth are not illuminatad by the sun: But, I know no man who as yet observed such things in the moon; and one may be rationally assured, that there are no vulcano's there, or that none of them burn at this time. And this all curious men, that have good telescopes, should well observe: And, I doubt not, that if we had a very particular map of the moon, that we, or our posterity would find some changes in her. And if the maps of *Hevelius*, *Divini*, and *Riccioli*, be exact, I can say, I have seen there places considerable enough, where they put parts that are clear, whereas I there see dark ones. 'Tis true, if there be seas in the moon, it can hardly fall out otherwise than on our earth, where alluviums, or new accessions of land are made in some places, and the sea gains on the land in others; I say, if these spots, to be seen in the moon be seas, as it is generally thought; whereas, I have many reasons to the contrary. And I have sometimes thought, that possibly, all the seas of the moon were on the other hemisphere, and that this might be the reason the moon revolves not on his axis, as our earth, wherein the lands and seas are, as it were, balanced: This also may be the cause of the non-appearance of clouds there, or of any vapours considerable enough to be seen,. as are raised from the earth; and that this absence of vapours may also be the reason that there is no twilight there, as it seems there is none; I my self at least not being able to discern any: For methinks, the reputed inhabitants of the moon might see our twilight, seeing it is far stronger than the light afforded us by the moon, even when full; for a little after sun-set, when we receive no more the first light of the sun, the sky is far clearer than it is in the fairest night of the full moon. And since we observe in the moon, in her increase or decrease, the light she receives from the earth; we cannot doubt but the people of the moon, should likewise see

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in the earth the light wherewith the moon illuminates it, with perhaps, the difference of their bigneſs. Much more than, ſhould they ſee the crepuſcular light, being, as was ſaid, incomparably greater; yet, we ſee not any faint light, beyond the ſection of the light, which is almoſt every where equally ſtrong, and we there diſtinguiſh nothing at all, not ſo much as that cleareſt part called *Ariſtarchus* or *Porphyrites*, as I have often tried; although one may there ſee the light which the earth ſends thither, which is ſometimes ſo ſtrong, that in the moons decreaſe, I have often diſtinctly ſeen all the parts of the moon, that were not enlightened by the ſun, together with the difference of the clear parts and the ſpots, ſo far as to be able to diſcern them all. The ſhadows alſo of all the cavities of the moon, ſeem to be ſtronger than they would be if there were a ſecond light. For although afar off the ſhadows of our bodies, environed with light, ſeem to us almoſt dark, yet they do not appear ſo much as the ſhadows of the moon do; and thoſe upon the edge of the ſection, ſhould not appear in the like manner. But I will determine nothing of any of theſe things.

To meaſure Diſtances *at one Station, by M.* Auzout. Phil. Tranſ. N° 7. p. 124.

I Found long ſince a method of meaſuring with a great teleſcope from one ſtation the diſtance of objects on the earth. The practice does not altogether anſwer the theory, becauſe the length of the teleſcope admits of ſome latitude, yet it comes near enough; and perhaps, is as juſt, as moſt of the ways commonly uſed with inſtruments. If we conſider the theory only, an ordinary teleſcope may be employed, whoſe eye-glaſs muſt be convex: For by putting the glaſſes at a little greater diſtance than they are, proportionably to the diſtance for which it is to ſerve, and by adding to it a new eye-glaſs, the object will be ſeen diſtinct, 'tho' obſcure; and if the eye-glaſs be convex, the object will appear erect. They may be done two manner of ways, either by leaving the teleſcope in its ordinary ſituation, the object-glaſs before the eye-glaſs; or by inverting it, and putting this before that. But if any will uſe two object glaſſes, whoſe focus's are known, their diſtances will be alſo known. If you ſuppoſe the focus of the firſt B, and that of the ſecond C, and the diſtance given $B + 2D$, and that $D - C$ be equal to F; for, this diſtance will be equal to $B + C + F - r F^2 C^2$. And if you have the focus of the firſt object-glaſs equal to B, the diſtance at which the ſecond glaſs is to be put, equal

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to $B + C + D$, the focus of the ſecond glaſs will be found equal to $\frac{CD}{C+D}$. And if you would have the object magnified as much with theſe two glaſſes as it would be with a ſingle one, whoſe focus ſhould be of the diſtance given, having the focus of the object-glaſs given equal to B, and the diſtance given to $B + D$; the diſtance between the firſt and ſecond glaſs will be equal to $\frac{2B^2 + 2BD}{2B + D}$; whence ſubducting B (the focus of the object given) there remains $\frac{BD}{2B + D}$, and if this ſum be ſuppoſed equal to C, we ſhall eaſily know by the preceeding rule, the focus of the ſecond glaſs.

A Way of preparing a Liquor *that will ſink into and ~~colour the whole Body of~~ Marble; ſo that a Picture drawn on its Surface, will appear alſo in its inmoſt Parts,* [*by* A. Kercher, Phil. Tranſ. N° 6. p. 125.]

T~~HE colours are thus~~ prepared; take of aqua-fortis, and aqua-regia, two ounces of each; of ſal-armoniac one ounce, of the beſt ſpirit of wine, two drams; as much gold as may be had for four ſhillings and ſix pence; of pure ſilver two drams. Theſe materials being provided, let the ſilver, when calcined, be but into a vial; and having poured upon it the two ounces of aqua-fortis, let it evaporate, and you will have a water, yielding firſt a blue, and afterwards a black colour: Likewiſe, put the gold, when calcined, into a vial, and having poured the aqua regia on it, ſet it by to evaporate; then pour the ſpirit of wine upon the ſal-armoniac, leaving it alſo to evaporate; and you will have a golden coloured water, which will afford divers colours. And after this manner you may extract many tinctures of colours out of other metals: This done, you may, by means of theſe two waters, paint what picture you pleaſe upon white marble of the ſofter kind, renewing the figure every day for ſome time with ſome freſh ſuperadded liquor; and you will find that the picture has penetrated the whole ſolidity of the ſtone, ſo that cutting it into as many parts as you will, it will always repreſent to you the ſame figure on both ſides.

But whether this experiment ſucceed or not; it is certain that Mr. *Bird*, a ſtone-cutter at *Oxford*, has many years ago found out a way of doing the ſame thing, and practiſed it for a long time;

time: That is, he can apply a colour to the outſide of poliſhed marble, that ſhall ſink a conſiderable depth into the body of the ſtone, and repreſent the ſame figures that are on its outſide, deeper or ſhallower, in proportion to the time of application. Several pieces of which are to be ſeen in *Oxford*, *London*, and elſewhere. And ſome of them being ſhown to his majeſty, ſoon after the reſtoration, they were broken in his preſence, and found to anſwer expectation.

An Account of an odd Spring *in* Weſtphalia; *as alſo of* Salt-Springs, *and the ſtraining of* Salt Water. Phil. Tranſ. N° 7. p. 127.

IN the Dioceſe of *Paderborn* in *Weſtphalia*, there is a ſpring which diſappears twice in 24 hours, returning always at the end of ſix hours with a great noiſe, and ſo forcibly as to drive three mills not far from its ſource. It is called the *Bolder-born*, that is, the boiſterous ſpring.

It is obſerved, that no ſalt water containing any metal in it, can be boiled in a veſſel of the ſame metal, except vitriol in copper veſſels.

To ſeparate ſalt from ſalt water without fire, take a veſſel of wax, hollow within, and every where tight; and plunge it into the ſea, or into other ſalt water, there will be made ſuch a ſeparation, that the veſſel will be full of ſweet water, the ſalt remaining behind: But though this water have no ſaltiſh taſte, yet there will be found a ſalt in the eſſay, which is the ſpirit of ſalt, ſubtile enough with the water to penetrate the wax.

The injecting of Liquors *into* Animals, *aſcertained to its true Inventor.* Phil. Tranſ. N° 7. p. 128.

IT is well known, that about ſix years ago (the date of this paper being *December* 1665, before which time no one ever pretended to have thought of it) the ingenious Dr. *Chriſtopher Wren*, then *Savilian* profeſſor of aſtronomy, communicated to the honourable Mr. *Boyle*, Dr. *Wilkins*, and others, that he could eaſily convey any liquor into the maſs of blood, by making ligatures on the veins, opening them between the ligature and the heart, and putting into them ſlender pipes or quills faſtened to bladders containing the matter to be injected. Upon this Mr. *Boyle* cauſed ſeveral experiments to be made on dogs, by injecting opium and the infuſion of Crocus Metallorum, and it was found that the former ſtupified, and the latter ſet them a vomiting to ſuch a degree that they died. It was perceived that beſides the

medical uſes of this invention, it might alſo ſerve for anatomical purpoſes, and by thus filling and diſtending the veſſels of animals, new ones might be diſcovered.

Of a remarkable Spring *near* Paderborn *in* Germany. Phil. Tranſ. N° 8. p. 133.

IN the Dioceſe of *Paderborn*, about two leagues from that town, is a ſpring, called *Metborne*, with three ſtreams, two whereof are not above 1 ½ foot diſtant from each other, and yet of ſo different qualities, that one of them is limpid, bluiſh, lukewarm, and bubbling; containing ſal-armoniac, oker, iron, vitriol, alum, ſulphur, nitre, and orpiment. It is uſed againſt epilepſies, diſtemper'd ſpleens, and the worms; the other is as cold as ice, turbid, and whitiſh, much ſtronger in taſte, and heavier than the former; containing much orpiment, ſalt, iron, nitre, ſome ſal-armoniac, alum, and vitriol. All birds that drink of this latter are obſerved to die, and this I have experienced myſelf by taking ſome of it home, and giving it to poultry after eating oats, barley, and bread crumbs; for ſoon after drinking it, they became giddy, reeled and tumbled on their backs with convulſions, and ſo died with their legs very much extended: Giving them common ſalt immediately on drinking it, they died not ſo ſoon; and giving vinegar they died not at all, but ſeven or eight days after were troubled with the pip; upon opening thoſe that died, their lungs were found quite ſhrivelled; yet people troubled with worms, diluting a little quantity of it in common water, have thereby killed and diſcharged great numbers of them; and though it makes them ſick, yet not to a degree of endangering their lives. The third ſtream lying lower than the other two, and about 20 paces diſtant from them, is of a greeniſh colour, very clear, and of a ſouriſh-ſweet taſte, which is agreeable enough. Its weight is a mean between that of the other two, whence it is probable that it is a mixture of both meeting in that place; to confirm which, we mixed equal quantities of thoſe two with a little common well-water, and found upon ſtirring them together, and ſuffering them to ſettle, that they produced a water of the ſame colour and taſte with this third ſtream.

Of the richeſt Salts *in* Germany. Phil. Tranſ. N° 8. p. 136.

THE ſalt ſprings at *Hall* in *Saxony* are four, called *Gutjahr*, the *Dutch Spring*, the *Wettritz*, and the *Hackeldorn*. The three firſt contain above ſeven parts of ſalt, three of marcaſites, and 14 of water. The laſt holds leſs, but yields the

pureſt ſalt. They are (beſides their ordinary uſe) employed medicinally to bath in, and a ſpirit is extracted from them, exhibited with ſucceſs againſt venom, and the putrefaction of the lungs, liver, reins, and ſpleen.

The ſalt water at *Lunenburgh* being more greeniſh than white, and not very tranſparent, is of the ſame nature and contents with that of *Hall*. It has a mixture of lead in it, which hinders its boiling in pans of that metal: And if it contained no lead at all, it would not be ſo good, that metal being judged to purify the water: Whence the *Lunenburg* ſalt is prefered to all others made of ſalt ſprings.

Swarms of ſtrange and miſchievous Inſects *in* New England. Phil. Tranſ. N° 8. p. 137.

SOME few years ſince in *New England*, there was ſuch a ſwarm of a certain ſort of inſects, that for the ſpace of 200 miles deſtroyed all the trees of the country. There was found a great number of holes in the ground, out of which they broke forth in the form of maggots, which became flies, with a kind of tail or ſting, which they ſtruck into the tree, and thereby envenomed and killed it.

The Brooding of Snakes *and* Vipers. Phil. Tranſ. N° 8. p. 138.

THERE is this difference between the brooding of ſnakes and vipers; the ſnakes lay their eggs in dunghills, by whoſe warmth they are hatched: But the vipers brood their eggs within their bellies, and bring forth live vipers. To which may be added, that ſome affirm to have ſeen ſnakes lie on their eggs like hens.

To preſerve Ice *and* Snow, *by Mr.* W. Ball. Philoſ. Tranſ. N° 8. p. 139.

THE ſnow and ice-houſes at *Leghorn* in *Italy*, are commonly built on the ſide of a ſteep hill, being only a deep hole in the ground, by which means they eaſily make a paſſage out from the bottom of it, to carry away all the water, which elſe, ſtagnating there, would melt the ice and ſnow. They are thatched with ſtraw, in the ſhape of a ſauce-pan cover, that the rain may not come at them. This pit is filled full of ſnow or ice, which muſt be of the pureſt water, becauſe to be uſed in their wine; after firſt ſpreading the bottom over with chaff, and I think they uſe barley-chaff. Then, as they put in the ice or ſnow (which latter they ram down) the ſides are thick lined with this chaff, and it

is afterwards covered over with it: And in half a year's time, 'tis found not to loſe an eighth part of its firſt weight. Whenever it is taken out into the air, they wrap it up in this chaff, and it keeps exceeding well.

The other uſual way both in *Italy* and other countries to preſerve ſnow and ice, is with ſtraw or reed.

Directions for Seamen *bound for long Voyages, by Mr.* Rook. Phil. Tranſ. N° 8. p. 140.

IT being the deſign of the Royal Society, for the better attaining the end of their inſtitution to ſtudy nature rather than books, and from the appearances ſhe preſents to compoſe ſuch a hiſtory as may lay a foundation for ſolid and uſeful philoſophy; for this purpoſe they gave orders to ſeveral of their members, and among others to Mr. *Rook*, geometry profeſſor of *Greſham* college, to draw up heads of inquiries for the direction of ſeamen in making obſervations in their voyages, which he accordingly executed, and are as follows:

1. To obſerve the declination of the compaſs, or its variation from the meridian, and withal the longitude and latitude of the place where ſuch obſervation is made, and to ſet down the method of taking them.

2. To carry dipping needles, and obſerve their inclination.

3. Carefully to obſerve the tides, in as many places as poſſible, with all their circumſtances, as the preciſe time of ebbing and flowing in rivers, at capes; the way of their currents, the perpendicular diſtance between the higheſt tide and loweſt ebb in ſpring and neap-tides; what day of the moon's age, and at what times of the year the higheſt and loweſt tides happen.

4. To make plots of the proſpect of coaſts, ports, promontories, and iſlands, marking the bearings and diſtances as near as poſſible.

5. To ſound and mark the depth of coaſts, ports, and other places, near the ſhore.

6. To obſerve in all ſoundings the nature of the ground at the bottom of the ſea, whether it be clay, ſand, rock, &c.

7. To keep a regiſter of all changes of wind and weather at all hours, both night and day, the point the wind blows from, and whether ſtrong or weak; the rains, hail, ſnow, &c. the preciſe time of their beginning and continuance, eſpecially hurricanes and ſpouts; and above all, carefully to obſerve the trade winds, about what degrees of latitude and longitude they firſt begin; where and when they ceaſe, change, or grow ſtronger or weaker, and how much.

8. To

8. To obſerve all extraordinary meteors, lightnings, thunders, *ignes fatui*, comets, *&c.* marking the places and time of their appearing, continuance, *&c.*

9. To carry with them good ſcales and glaſs vials of a pint or ſo, with narrow mouths, to be filled with ſea water in different latitudes, in order to know its weight, as well of water near the ſurface as at greater depths.

To find the Diſtance of the Sun *and* Moon *by the* Parallax. Phil. Tranſ. N° 9. p. 151.

THE finding this diſtance may prove of important uſe for perfecting aſtronomy, and for the better eſtabliſhing of the doctrine of refractions. For executing which, the following method is propoſed, *viz.* That at certain times agreed on by two obſervers, uſing large and proper teleſcopes, with a meaſuring rod placed within the eye-glaſs, at a convenient diſtance, that it may be diſtinctly ſeen, and may ſerve for meaſuring ſmall diſtances to minutes and ſeconds; let each of them thus furniſhed, obſerve the viſible way of the moon among the fixt ſtars, by taking her exact diſtance from any ſtar that lies in or very near her way, together with the exact time of ſuch appearance, and the then apparent diameter of her diſk: Continuing theſe obſervations every time for two or three hours, ſo that two exact ones of her apparent place among the fixt ſtars being made at the ſame time, at two places diſtant in latitude, and nearly under the ſame meridian, her true diſtance may be thence collected, not only for that time, but at all other times by any ſingle obſerver, viewing her with a teleſcope, and meaſuring exactly her apparent diameter. It were alſo to be wiſhed that in any conſiderable eclipſe of the ſun, they would alſo obſerve the exact meaſure of the greateſt obſcuration compared with the apparent diameter of the diſk. For by this means, on finding exactly the diſtance of the moon, that of the ſun will eaſily be deduced.

The propereſt time for making obſervations of the moon, will be when ſhe is about a quarter or ſomewhat leſs illuminated, becauſe then her light is not ſo bright, but that with a good teleſcope ſhe may be obſerved to paſs cloſe by, and ſometimes over ſeveral fixt ſtars, which is about four or five days before or after her change: Or elſe at any other time, when the moon paſſes near or over ſome of the bigger ſort of fixt ſtars; which may be eaſily calculated and foreſeen: Or beſt of all, when there is any total eclipſe of the moon, for then the ſmalleſt teleſcopical ſtars may be ſeen cloſe to her body.

Baro-

Barometers, *and Obſervations made with them, by Dr.* Beal. Phil. Tranſ. N° 9. p. 153.

THE Barometer, is an inſtrument for meaſuring the weight of the atmoſphere, thereby to determine the changes of the weather: It is founded on the *torricellian* experiment, ſo called from its inventor *Torricelli*, which is only a glaſs tube filled with mercury, hermetically ſealed at one end, with the other open, and immerged in ſtagnant mercury. The barometer was firſt made publick by Mr. *Boyle*, and employed by him and others to diſcover all the minute variations in the preſſure and weight of the air. With this inſtrument he made divers obſervations in 1659 and 1660, before any others were publick or heard of by him.

Dr. *Beal* is ſo taken with the diſcoveries already made with this inſtrument, that he looks upon it as one of the moſt extraordinary inventions in the world. " Who could have thought (ſays he) " that men ſhould find an art to weigh the air, that hangs over " their heads, in all its changes; and even diſtinguiſh by weight " the winds and clouds? Or, who could have imagined that the " cleareſt air is the heavieſt, and the thickeſt air, when loaded " with clouds, ready to diſſolve and fall, ſhould then be the " lighteſt?" Hence the Doctor deſcends to particular obſervations.

And firſt, he ſays, he could never fill his wheel-barometer ſo exactly with mercury, as to exclude all air; and therefore he depended more on the mercurial cylinder, from which he took all his notes. Its length is but 35 inches, of a narrow bore, and a thick glaſs.

2. In all his obſervations from *May* 28th, 1664, to *December* 9th, 1665, the quickſilver never aſcended but very little above 30 $\frac{1}{4}$ inches.

3. It aſcended ſeldom ſo high, eſpecially on *December* 13th, 1664, the weather being changeable, and the evening fair.

4. By his calendar of *June* 22d, 1664, at five in the morning, in a long tract of fair ſettled weather, the mercury aſcended about half an inch higher than 30. So that the mercury may riſe as high in the hotteſt ſummer, as in the coldeſt winter.

5. He had obſerved it aſcend higher in cold weather; and very frequently both in winter and ſummer to be higher in the cold mornings and evenings, than in the warmer mid-day.

6. Generally in ſettled and fair weather, both winter and ſummer, the mercury is higher than a little before, or after, or in rainy weather.

7. Again

7. Again, it deſcended generally lower after rain, than it ſtood before rain.

8. It falls alſo generally in great winds, and it ſeemed to ſink a little upon opening a wide door to let in ſtormy winds: Yet he found it to continue very high in a long ſtormy wind of three or four days.

9. Again, it is generally higher in an eaſt and north wind, than in a ſouth and weſt wind.

10. He tried ſeveral times to alter the air in his cloſet by fumes and thick ſmokes; but the mercury ſeemed not to be affected, more than what might be expected from ſome increaſe of heat: Such as have exact wheel-barometers, may try whether odours or fumes make the air lighter.

11. He did not find in all this time the greateſt changes of the quickſilver to amount to more than 2 $\frac{3}{4}$ or 2 $\frac{7}{8}$ inches, at moſt.

12. He very often found great changes in the air, without any perceptible change in the barometer; as in dewy nights, when the moiſture deſcends plentifully. On the preceeding and following days the vapours have been raiſed ſo inviſibly, that the air ſeemed very clear. Which riſing and falling of vapours import gravity and levity of air, and yet the barometer was not affected thereby.

13. The barometer is not ſometimes moved by very great changes in the air: As *December* 18th, an extraordinary bright and clear day, and the next following quite dark, ſome ſnow and rain falling, but the mercury was at the ſame height; ſo in high winds and calms, the ſame.

14. *December* 16, 1665, was a clear cold day, with a very ſharp and ſtrong eaſt wind; the mercury very near 30 inches high; about three in the afternoon he ſaw a large black cloud approaching from the eaſt and ſouth-eaſt, with the wind at eaſt. The mercury changed not that day nor the following, the ſtars and moſt of the ſky were very bright and clear till nine o'clock; and then the ſky was ſuddenly overcaſt, yet no change of weather happened. *December* 17th, the froſt held, and it was a clear day, till about two o'clock in the afternoon; and then many thick clouds appeared low in the weſt; yet no change of weather; the wind, froſt, and quickſilver the ſame. *December* 18th, the mercury fell almoſt $\frac{1}{4}$ of an inch, and yet the ſky and air were clear, bright, and cold, with an eaſt-wind; but accidently ſending his ſervant abroad, he diſcovered the remote hills, about 20 miles off, covered with ſnow.

15. He

15. He ſeldom obſerved the change to be very great at any one time; ſo that he once wondered to ſee, that in one day it ſubſided about $\frac{3}{4}$ of an inch.

16. *Jan.* 13, 166$\frac{5}{6}$, the mercury ſtood a quarter above 30 inches, as it did alſo the day before; yet both very dark and cloudy, ſometimes very thick and miſty air; which is an uncommon caſe, for generally it ſtands higher in the cleareſt ſettled weather, then in ſuch cloudy and miſty fogs. This thick air and darkneſs laſted above a week; lately more cold, and eaſt and north-eaſt wind.

17. In *Jan.* 166$\frac{5}{6}$, for many days it continued very dark, ſo that great rains were apprehended, and though ſometimes thick miſts aroſe and ſome ſmall rain fell, yet the mercury ſtood at a great height; which indicated no great change of weather, and he was not diſappointed.

18. If the mercury riſes a good height after the fall of rain, as ſometimes it does, then he looks for a ſettled ſerenity; but if it falls, then he expects a ſeries of broken and ſhowry weather.

19. The weather and our bodies are more chill, cold, and drooping, when the mercury is loweſt and the air lighteſt. Air being to us, what water is to fiſhes.

20. The loweſt deſcent of the mercury, in all his obſervations, was *October* 26, 1665, in the evening; when it was very near at 27 $\frac{1}{2}$ inches; as he finds by his following notes: *October* 25, morning, mercury at 28 $\frac{1}{2}$ inches, great ſtorms and much rain. *October* 26, morning; mercury at 28, winds quiet, thick dark clouds. *October* 26, evening; mercury at 27 $\frac{1}{2}$; that day and the following days, the weather was variable, and frequent rains.

21. He ſet a wind-vane of a large braſs ſtreamer over the place where the mercurial tube ſtood, and pointing to a board indented in the margin, that he could take at a good diſtance the 32 points of the wind, with the half and quarter points. It would be proper to have an index of winds.

22. By change of weather and wind, the mercury ſunk, ſince *March* 12th, above an inch; and *March* 18th at night, by rain and ſouth wind, half an inch.

23. He found the quickſilver, *December* 16th, 1669, higher than ever he obſerved it, it being half an inch above 30. It continued the 14th, and a part of the 15th at about that height, and ſometimes higher to an eighth or tenth part of an inch. For this barometer he had two glaſs tubes in one veſſel of ſtagnant mercury; and both of them agreed in this indication. The weather was at firſt, very bright, clear, and a mild froſt: The air

was very ſilent, and no wind ſtirring, and by the wind-vane, the wind ſtood eaſt, all the firſt day, *viz.* *December* 13th; on the 14th it blew a little from north-weſt, and returned again to the eaſt, or north-eaſt. During this ſhifting of winds, the mercury deſcended a little; and again, after ſettling of the wind, the mercury aſcended a little higher than it had the preceeding day.

The houſe and ſtudy where this barometer was kept, ſtood on the ſide of a hill, on the higher ſide of the country, and nearly on a level with the head of a river that falls into the *Severn* ſea, about 20 or 30 miles weſtward of *Briſtol*, ſo that they cannot be much above the level of the ſea.

Some Obſervations of Vipers, *by* Sig. Franceſco Redi. Phil. Tranſ. N° 9. p. 160.

SIG. *Redi* obſerves that the poiſon of vipers is neither in their teeth, their tail, nor their gall; but in the two veſicles or bladders which cover their teeth, and which upon compreſſion, when the vipers bite, emit a certain yellowiſh liquor, that runs along the teeth and infects the wound. To prove this, he rubbed the wounds of many animals with the gall of vipers, and prick'd them with their teeth without any ill conſequences; but upon rubbing with the above yellow liquor, not one of them eſcaped.

It was commonly thought that ſwallowing the poiſon of vipers was preſent death, but after many trials he obſerved, that they have neither humour, nor excrement, nor any part, not even the gall itſelf, that being ſwallowed is mortal. And this is to be attributed to the nature of thoſe poiſons, which ceaſe to be ſuch when ſwallowed, and are only noxious when immediately conveyed into the blood.

He obſerves the falſehood of what ſome authors affirm, *viz.* that it is mortal to eat of the fleſh of creatures killed by vipers; or to drink of the wine wherein they have been drowned, or to ſuck the parts they have wounded. On the contrary he declares, the ſucking the wound a ſovereign remedy againſt the bite of vipers; for cauſing a dog to be bitten in the noſe, he ſaved his life by licking his own wound; and which he confirms by the example of the *Marſi* and *Pſilli*, people famous in hiſtory for healing the bites of ſerpents by ſucking the wounds.

He adds that though *Galen*, and many modern phyſicians affirm, that nothing cauſes more thirſt than vipers fleſh, yet he experienced the contrary. He denies that the ſalt of vipers has any purging quality; as alſo what *Ariſtotle* aſſures, and *Galen* had often tried, that the ſpittle of a perſon faſting would deſtroy vipers.

An Earthquake *near* Oxford, Anno 1665, *by Dr.* Wallis *and Mr.* Boyle. Phil. Tranſ. N° 10. p. 166, *&c.*

ON the 19th of *January*, 166$\frac{5}{6}$, towards evening, at divers places near *Oxford*, was felt a ſmall earthquake. At *Oxford* itſelf it was not perceived; the Doctor ſays, that about that time he was ſenſible of a kind of odd ſhaking or heaving in his ſtudy, which he ſuppoſed owing to carts or coaches, though a little different from what is uſual on theſe occaſions.

It was perceived at *Blechington*, above five miles northward of *Oxford*, and alſo at *Boſtol*, *Horton*, *Stanton* St. *John*'s, and ſo towards *Whately*, which is four miles to the eaſt of *Oxford*: It was not felt at the ſame time at all theſe places, but moved ſucceſſively from *Blechington* to *Whately*.

Mr. *Boyle* riding between *Oxford* and a lodging he had about four miles from that town, in that ſhort ſpace of time from a ſettled froſt, the wind turned and it begun to rain. Soon after his getting home, he felt a manifeſt trembling in the houſe, which ſtands high in reſpect of *Oxford*. But he would not have taken notice of it as an earthquake, unleſs it had been perceived by the people of the houſe. Soon after there happened a briſk ſtorm; on which he ſent to make inquiry at a place called *Brill*, which ſtanding higher might be ſuppoſed more liable to the effects of the earthquake; and he was informed that it was very conſiderable there; and that a gentleman's houſe in the neighbourhood ſhook very much, ſo that the ſtones in the parlour manifeſtly moved to and fro. The hill on which this *Brill* ſtands, is ſtored with mineral ſubſtances of ſeveral ſorts. Mr. *Boyle* adds, that he has been told that this earthquake reached a great many miles.

Obſervations on the Barometer, *by Dr.* Wallis. Phil. Tranſ. N° 10. p. 169.

THE Doctor never obſerved the quickſilver higher than 30 inches, nor lower than 28, at leaſt the difference between higheſt and loweſt was never $\frac{1}{16}$ of an inch.

In thick foggy weather, he found the quickſilver riſe; which he aſcribes to the heavineſs of the vapours in the air.

In ſun-ſhiny weather it riſes alſo, and commonly in clear weather it is higher; which may be owing partly to the vapours raiſed by the ſun and encreaſing the weight of the air; partly to the heat which adds to the elaſticity of the air; which latter he mentions, becauſe in ſun-ſhiny weather, which became afterwards cloudy

for an hour or two, the quickſilver was fallen; and then on the ſun's breaking out again, it was riſen as before.

In rainy weather it falls, becauſe the air is light in proportion to the quantity of vapours that falls; and alſo in ſnowy weather, but not ſo much as in rain; and ſometimes it has fallen upon a hoar-froſt in the night.

In windy weather it generally falls and more diſcernably than in rainy, owing poſſibly to the winds moving the air laterally; and thereby preventing its preſſure downwards; and he never found it lower than in high winds.

He obſerved the quickſilver fall without any viſible cauſe, but upon looking abroad, he found it had rained at ſome diſtance; whereby the heavier air might have in part diſcharged itſelf on the lighter.

The Revolution of Jupiter *upon his Axis, by Mr.* Hook *and M.* Caſſini. Phil. Tranſ. N° 10. p. 172. *&c.*

ABOUT 9 o'clock at night *May* 9th, *Anno* 1664, Mr. *Hook* obſerved with a good 12 foot teleſcope a ſmall ſpot in the biggeſt of the three obſcurer belts of *Jupiter*; and obſerving it from time to time, he found that within two hours after, the ſaid ſpot had moved from eaſt to weſt, about half the length of the diameter of *Jupiter*.

According to M. *Caſſini* there are two ſorts of ſpots to be ſeen in the diſk of *Jupiter*, one on the ſhadows of his ſatellites the other reſembling thoſe that are ſeen in the moon; and are perhaps of the ſame nature with thoſe called belts. They move from the eaſtern to the weſtern limb; their apparent motion is unequal, and ſwifter near the center than the circumference; and they are never ſeen ſo well as when they approach the center; for in approaching the circumference they become very narrow and almoſt imperceptible; which induces one to believe that they are flat and ſuperficial.

Among theſe ſpots there is none ſo obſervable as that ſituated in the northern part of the ſouthern belt. Its diameter is $\frac{1}{10}$ of *Jupiter*'s; its center is diſtant from that of *Jupiter* about $\frac{1}{3}$ of the ſemidiameter of that planet.

M. *Caſſini*, after many obſervations during the ſummer 1665, found, that the period of its apparent revolution is nine hours 56′. He continued to obſerve this Spot till the beginning of 1666, when *Jupiter* approached to the beams of the ſun, but after he got out of them it was hard to be diſcerned: This giving grounds to think that it might be of the nature of the ſolar ſpots, which appearing for a while, diſappear for ever, M. *Caſſini* intermitted his obſervations. But

But *Jan.* 19th, 1672, N. S. obſerving *Jupiter* at 4 ¾ hour in the morning, he perceived in the ſame place of his diſk the figure of the ſame ſpot, adhering to the ſame ſouthern belt. It had already gone over the half of this belt, and he ſaw it advance gradually towards the weſtern limb, to which it ſeemed very near at 6 ¼ hour.

By the celerity of its motion near the center, and by the place where he had begun to ſee it, he judged it might have been in the middle of the belt at 4 hours 35′ in the morning. And as he ſet about making ephemerides of its motion for 1672, he perceived that in thoſe he made for 1666, this ſpot had been in the middle of *Jupiter* the ſame day, *viz.* the 19th of *Jan.* at the ſame hour, ſo that in ſix years, of which one is a biſſextile, it is found to have made, in reſpect of the earth, at leaſt 5294 revolutions, each of 9 hours, 55′. 85″. one revolution with another; and at moſt, 5294 revolutions of 9 hours, 55′. 51″. for as much as he was aſſured of the preciſeneſs of one mean revolution to ⅛ of a minute.

Until then he never obſerved an immediate return of this ſpot after 9 hours, 56′; becauſe that after the appearing of the ſpot, *Jupiter* had not continued long enough above the horizon to obſerve him with due diſtinctneſs. But the night after, *March* 1ſt, at 7 ½ hours in the evening, he ſaw this ſpot in the middle of the belt, and the ſame night at 5 hours, 26′. in the morning, he ſaw it again return preciſely to the ſame place.

Obſervations and Directions about the Barometer, *by Mr.* Boyle. Phil. Tranſ. N° 11. p. 181.

IT will be requiſite for the obſervers to give an account of the ſituation of the place, where the barometers ſtand; becauſe hereby one may not only be capable of judging, whether the inſtruments were duly perfected, but becauſe the obſervations may diſagree, even when the atmoſphere is in the ſame ſtate, as to weight, if one of them ſtand in a higher part of the country than the other. For Mr. *Boyle* found by comparing two barometers he had, the one at *Oxford*, the other at *Stanton* St. *John*'s, that though the former was a very good one, and the latter very carefully filled; yet becauſe at *Stanton*, the higher ground, the incumbent part of the atmoſphere muſt be lighter, than at *Oxford* the lower place; there is generally between 2 and 3 eights of an inch difference.

But as moſt of the barometrical obſervations are ſubject to exceptions, ſo he found that to be the caſe of the former. For riding

riding one evening from *Oxford* to *Stanton*, and before he took horse looking on the barometer, he was surprized to find at his coming to the latter place, which was at no great distance, and also considering the shortness of the time, which was an hour and a half, that the barometer at *Stanton* was short of its usual height from the other, near a quarter of an inch; though the weather being fair and calm, there appeared no manifest change in the air; and also since that time the mercury in the two instruments had for the most part risen and fallen as before.

Mr. *Boyle* has observed the heights of the mercury to be greatest in droughts, which he supposes owing to the elevation of steams from the earth, which may gradually increase the weight of the atmosphere; for *March* 12, 166$\frac{5}{6}$, at *Oxford* the quicksilver was higher than had been observed in *England*, *viz.* about $\frac{5}{16}$ above 30 inches; but upon the first considerable showers that interrupted the long drought, he foretold many hours before that the mercury would be very low, and so he found it at *Stanton* to fall $\frac{3}{8}$ beneath 29 inches, there being also a blustering wind with the rain.

It is difficult enough to settle any general rule about the rising and falling of the mercury; yet in those parts, one that seems to hold ofteneft, is, that when high winds blow, the mercury is lowest, and yet this sometimes fails.

General Heads for a Natural History of a Country, *by Mr.* Boyle. Phil. Transf. N° 11. p. 186.

THE things to be observed in such a history may be reduced to these following, such as regard either the *Heavens*, the *Air*, the *Water*, or the *Earth*.

1. To the first sort of particulars belong the longitude and latitude of the place, and consequently the length of the longest and shortest days and nights, the climate, parallels, &c. What fixt stars are or are not visible there?

2. As to the Air, its temperature as to its four qualities may be observed; its weight, clearness, refractive power, subtilty or grossness; its abounding with salts, its variations according to the seasons of the year and times of the day; the usual duration of the several kinds of weather: What meteors it produces; especially what winds it is subject to, whether any of them be stated and ordinary? &c. What diseases are epidemical; the usual salubrity or insalubrity of the air, and with what constitutions it agrees?

3. About the Water, may be observed, the sea, its depth, degree of saltness, tides, currents, &c. Rivers, their bigness, length,

length, courſe, inundations, goodneſs, lightneſs of waters, &c. Then lakes, ponds, ſprings, and eſpecially mineral waters, their kinds, virtues, and how examined? To the waters belong alſo, fiſhes, their kinds, whether ſalt or freſh water fiſh; their plentifulneſs, bigneſs, goodneſs, ſeaſons, haunts, and the ways of taking them?

4. In the Earth, may be conſidered, 1. Itſelf. 2. Its inhabitants and its productions, both external and internal.

1. In the Earth itſelf, may be obſerved, its dimenſions, ſituation in reſpect of the points of the compaſs; its figure, plains and valleys, and their extent; its hills and mountains, and their height; and whether they lie ſcattered or in ridges, and in what direction theſe run? &c. The promontories, vulcano's, &c. in the country, what the magnetical declination is in ſeveral places, and the variations of that declination in the ſame place; what the nature of the ſoil is, whether clayey, ſandy? &c. What grain, fruits, and other vegetables thrive in it? How the inhabitants improve the advantages, and remedy the inconveniences of their ſoil?

2. Muſt follow an account of the Inhabitants themſelves, as their ſtature, ſhape, colour, features, ſtrength, agility, beauty, complexions, hair, diet, inclinations, and cuſtoms. As to the women, their fruitfulneſs or barrenneſs, their hard or eaſy labour, &c. What diſeaſes both men and women are ſubject to, and the unuſual ſymptoms in them?

As to the external productions of the Earth; we are to obſerve its graſs, grain, herbs, flowers, fruit-trees, timber-trees, coppices, groves, woods, foreſts, &c. The ſoil and culture with which they thrive; the animals of the country, either wild or tame.

The internal productions, are all ſorts of minerals, quarries, clays, earths, coals, ſalt-mines, alum, vitriol, ſulphur, &c. Metals, and a deſcription of their mines, their number, ſituation, depth, ſigns, waters, damps, quantity of ore, and its goodneſs, the methods of reducing their ores into metals, &c.

Preſerving of Ships *from being Worm-eaten.* Phil. Tranſ. N° 11. p. 190.

IN the *Indian* ſeas, there is a ſpecies of ſmall worms, that faſten themſelves to the timber of ſhips, and ſo pierce them, that they leak water, or ſo weaken the wood, that it is impoſſible to repair them. Some have lined their ſhips with deal, hair, and lime, &c. but beſides that, this does not altogether prevent the worms, yet it much hinders the ſhip's way. The *Portugueze* ſcorch their ſhips to ſuch a degree, that in the quick works there

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is formed a crusty burnt coat of about an inch thick: But this very often endangers the whole ship; though otherwise their ships are proof against them, as being of a harder timber. A person in *Holland* pretends to have found out a remedy for this evil; and one in *London* suggests, that the pitch extracted out of sea coals, is a proper cure for these noxious animals.

Preserving Birds *taken out of the Egg, by Mr.* Boyle. Phil. Transf. N° 12. p. 199.

IN order to observe the process of nature in the formation of a chick, Mr. *Boyle* opened the eggs at different periods after incubation, and carefully taking out the embryo's, embalmed each of them, in a distinct glass carefully stopt, in spirit of wine. In making these experiments, some circumstances are to be observed; one is, that he had generally mixed with the spirit of wine a little spirit of sal armoniac. The other circumstance is, that it is proper to put them for some time in ordinary spirit of wine, to wash off the looser filth, and then let them soak in the same kind of spirit or, better, that the fœtus being removed into more pure and dephlegmated spirit of wine, it might not discolour it.

An unusual Way of propagating Mulberry-Trees *in* Virginia. Phil. Transf. N° 12. p. 201.

I Have planted ten thousand mulberry-trees, and hope within two or three years to have good silk by them. My method, which is uncommon, advances them two or three years growth sooner than if they were sown in seed; I intend likewise to plant them as thick as hedges, like currants or goosberries. By this method they will always be young, tender plants, and be easily cut in great quantities with a pair of garden-sheers; whereby one man may gather as much, as four could do, when they are in trees at distance from each other. But possibly the best way would be to sow some acres with mulberry seed, and to cut them with a scythe, and ever after keep them under.

A Method of making a Glass *of a small* Plano-convex Sphere *to refract the Rays of Light to a Focus of a greater Distance than usual, by Mr.* Hook. Phil. Transf. N° 12. p. 202.

PREPARE two glasses, the one exactly flat on both sides, the other flat on one and convex on the other, of any sphere you please. Let the flat glass be a little broader than the other, and let them both be put into a ring of brass, and so fastened with cement that their plane surface may be exactly parallel, and the

the convex ſide of the plano-convex glaſs lie inward, ſo as not to touch the flat of the other. Then fill the ſpace between, by a ſmall hole in the ſide of the braſs ring, with water, oil of turpentine, ſpirit of wine, ſaline liquors, *&c.* and then ſtop the hole with a ſcrew, and according to the different refraction of the liquors, ſo ſhall the focus be longer or ſhorter.

This is but one inſtance, of many, of the poſſibility of making a glaſs, ground in a ſmaller ſphere, to conſtitute a teleſcope of a much greater length; though I muſt add that of ſpherical optic glaſſes, thoſe are the beſt which are made of the greateſt ſphere, and whoſe ſubſtance has the greateſt refraction.

Shining Worms *in Oyſters, by M.* Auzout. Philoſ. Tranſ. N° 12. p. 203.

M. *Auzout* obſerved a ſhining clammy moiſture in oyſters, which ſtuck to the ſhell, and being drawn out ſhone in the air its whole length, which was four or five lines, and continued to ſhine for ſome time, when laid on the obſerver's hand. And afterwards opening more than twenty dozen of oyſters in the dark, he found this ſhining ſubſtance to be really worms, and thoſe of three ſorts. One was whitiſh, having 24 or 25 forked feet on each ſide, with a black ſpeck on one ſide of the head, taken by him for a cryſtalline, and the back like an eel ſtript of her ſkin; the ſecond was red, and reſembling the common glow-worm found on land, with folds on their backs and feet like the former, and a noſe like that of a dog, and one eye; the third ſort was ſpeckled, with a head like a ſoal, and with many tufts of whitiſh hair on its ſides.

There was a bigger ſpecies that was grayiſh, with a big head, and two horns like thoſe of a ſnail, and ſeven or eight whitiſh feet; but theſe ſhined not.

The two former ſorts conſiſt of a matter eaſily diſſolvable, the leaſt touch turning them into a viſcous and aqueous matter, which falling from the ſhell ſtuck to the obſerver's fingers, and ſhone there for 20 ſeconds; and if any part of it fell to the ground, it appeared like a ſmall piece of flaming brimſtone, and when ſhook off nimbly, it ſeemed a ſmall ſhining line, which was diſſipated, before it reached the ground.

This ſhining matter was of different colours; ſome whitiſh, and ſome reddiſh; but both afforded a violet colour to the eye.

He obſerved two, more firm than the reſt, which ſhone all over; and when they fell from the oyſter twinkled like a great ſtar, ſhining ſtrongly, and emitting, by turns, rays of a violet

light for 20 ſeconds. Which ſparkling was owing to the motions of the worm, for when dead they ſhone not.

Shaking ſtrongly the oyſter-ſhells in the dark, he ſometimes ſaw the whole ſhell full of light, and abundance of clammy matter burſt in their holes; and in ſhaking he obſerved all the communications of theſe holes like thoſe of worms in wood.

Almoſt all the oyſters he ſhook emitted light; and he found ſome of this light in ſixteen of the oyſters themſelves.

This light is more commonly in big than ſmall oyſters; in thoſe that are pierced by the worm oftner than in thoſe that are not; and rather on the convex ſide than the other; and more in freſh than ſtale ones.

Upon ſomewhat ſcaling the convex ſide of the ſhell, and diſcovering the communication of the holes, wherein the viſcous moiſture, that has any form of worms, is found, he ſmelt a ſcent like the water of a ſqueezed oyſter.

The worms give no light when irritated; and if they do, it laſts but a little time; whereas in thoſe that are not provoked, it continues a good while; the obſerver affirming to have kept of it above two hours.

The Effects of Touch *and* Friction. Phil. Tranſ. N° 12. p. 206.

MY Lord *Bacon* obſerves, that motion and warmth (of both which friction conſiſts) draws forth into the parts new juice and vigour, and conduce much to longevity. And Mr. *Boyle*, that a horſe well curried, is half fed; and that ſome can tell by their aſſes milk, whether that day they have been well curried or not; concluding, that if the alteration be ſo conſiderable in milk, it muſt be ſo likewiſe in the blood, and other juices and parts of the body. In *Braſil* they cure cold and chronical diſeaſes by Frictions, as they do acute ones by unction.

Dr. *Beale* communicated an inſtance of curing a dangerous wen by the application of a dead man's hand; whence the patient felt ſuch a cold ſtream reaching his heart, that it almoſt threw him into a ſwoon. That a certain cook, with warty hands, in a noble family, was bid by his lord to rub his hands with that of a dead man; and his lord dying ſome time after, the cook made uſe of his lordſhip's advice and hands, and ſoon found the good effect. That an aged gentleman in *Ireland*, who had great pains in his feet, inſomuch that he could not walk, ſuffered a ſpaniel to lick his feet morning and evening, till he found the pain abated, and recovered the uſe of his feet. That he knew a blackſmith, who vomited by ſtroaking the ſtomach; purged by ſtroaking the belly; and eaſed the gout and other pains by ſtroaking the parts affected.

A new

A new Contrivance of a Wheel-Barometer, *by Dr.* Hook, Phil. Tranf. N° 13. p. 218.

THIS is only an eafy way of applying an index to any common Barofcope, whether the glafs be only a fingle tube or have a round bolt head at top; and by it the variation of the altitude of the mercurial cylinder, which at moft is hardly three inches, may be made as diftinguifhable, as if it were three feet.

The manner hereof is plain by Fig. 1. in Plate II. where ABC reprefents the tube, which may be either obtufe or with a head, as A. This is to be filled with quickfilver, and inverted as ufual, into a veffel of ftagnant mercury of the fhape of I K, that is, with its fides about 3 or 4 inches high, and its bore equally big both above and below; and if poffible, of equal capacity with the hollow of the tube about B; for then the quickfilver rifing as much in the hollow of I, as it defcends at B, the difference of the height in the receiver I will be juft half the ufual difference. And if the receiving veffel I K have a bigger cavity, the difference will be lefs; but if lefs, the difference will be greater: But whether the difference be made greater or lefs, 'tis no great matter, fince by the contrivance of the wheel and index, the leaft variation may be made as fenfible as defired, by diminifhing the bignefs of the cylinder E, and lengthning the index F G according to the proportion required.

Of four Suns, *and two unufual* Rainbows *obferved in* France. Phil. Tranf. N° 13. p. 219.

THE 9th of *April* 1666, about half an hour paft 9, there appeared three circles in the fky; one of them S C H N, Fig. 2. was very large, a little interrupted and white all over, without any other colour. It paffed through the middle of the fun's difk, and was parallel to the horizon; its diameter was above 100 degrees, and its center not far from the zenith A.

The fecond D E B O was much lefs, and deficient in fome places, with the colours of a rainbow, efpecially in that part of it within the great circle; it had the true fun R for its center.

The third H D N was leffer than the firft, but greater than the fecond; it was not entire, but only an arch or portion of a circle, whofe center was far diftant from that of the fun, and whofe circumference about its middle D was joined to that of the leaft circle, interfecting at its two extremities H N, the great circle. This circle exhibited alfo the colours of a rainbow, but not fo ftrong as thofe of the fecond.

At that part, where the circumference of this third circle coincided with that of the ſecond, there was a very bright mixture of rainbow colours; and at the interſections of the ſecond with the firſt, appeared two Parhelia's or Mock-ſuns H N; which ſhone very bright, but not ſo bright, or well defined, as the true ſun. The middle of theſe two mock-ſuns was white and very luminous, and their extremities towards D I were tinged with rainbow colours. The falſe ſun H towards the ſouth, was bigger and far more luminous than that towards the eaſt.

There was alſo a third mock-ſun C on the firſt great circle to the north, which was ſmaller, all over white, and far leſs bright than the two others. There was alſo a very dark ſpace I, between R and D.

This appearance is looked upon as one of the moſt extraordinary that can be ſeen, becauſe of the excentricity of the circle H D N, and that the parhelia were not in the interſection of the circle D E B O with the circle S C H N, but in that of the ſemicircle H D N, which is different from the poſition of thoſe five ſuns that appeared at *Rome*, *March* 29th, 1629, between two and three o'clock in the afternoon; two of them appearing in the interſection of a circle that paſſed through the ſun's diſk, with another, that was concentric to the ſun. See Fig. 3.

As for the two unuſual rainbows, they appeared at *Chartres*, *Auguſt* 10th, 1665, about half an hour paſt ſix in the evening, croſſing one another almoſt at right angles. Fig. 4. That oppoſite to the ſun, in the uſual manner, was more deeply tinged than that which croſſed it; though indeed the colours of the firſt iris were not ſo ſtrong as at other times.

The greateſt height of the ſtronger rainbow, was about 45 degrees; the feebler rainbow loſt one of its legs about 20 degrees above the ſtronger, by growing fainter; and the lower leg appeared continued to the horizon. The fainter ſeemed to be a portion of a great circle, and the ſtronger, of a ſmall one as uſual.

The ſun, at their appearance, was about ſix degrees above the horizon; the river of *Chartres*, which nearly runs from ſouth to north, was between the obſerver and the rainbow, and he ſtood level with the river, at the diſtance of 150 paces from it.

An Accident by Thunder *and* Lightning *at* Oxford, *by Dr.* Wallis. Phil. Tranſ. N° 13. p. 222.

MAY 10th, 1666, about five o'clock in the afternoon, the thunder which he had heard before at ſome diſtance, coming nearer, it began to rain; and ſoon after, the thunder became very

very loud and frequent, and with long rattling claps. The flaſhes of lightning were very bright, though it was clear day-light, and often repeated; ſcarce a full minute between one flaſh and the other; and very often a ſecond flaſh, before the thunder of the firſt was heard, and generally about eight or ten ſeconds after the flaſh: But once or twice immediatly upon it, and in the ſame moment, the lightning became extreme red and fiery. He was very apprehenſive of the miſchief that might be done by it, for it ſeemed to be very low and very near, and ſo frequent and bright, that had it happened in the night-time, it would have been very terrible. Though he kept within doors, yet he ſenſibly perceived a ſtinking ſulphurous ſmell in the air. About ſeven o'clock it ended, before which time he had an account of a ſad accident upon the water at *Medley*, about a mile from *Oxford*; two ſcholars of *Wadham* college were ſtruck out of a boat into the water, one of them ſtark dead: The other ſtuck in the mud with his upper parts above water, but beſides the fright, had no other hurt.

He that was dead, was next morning brought to town; and Dr. *Willis*, Dr. *Millington*, Dr. *Lower*, and himſelf with ſome others went to view the corps: There was no wound in the ſkin, the face and neck were black, but no more than what might be cauſed by the ſettling of the blood: On the right ſide of the neck was a little blackiſh ſpot about an inch long, and a quarter of an inch broad, as if it had been ſeared with a hot iron, and another ſomewhat bigger on the left ſide of the neck, below the ear. Down the breaſt towards the left ſide, a ſpace of about three quarters of a foot in length, and two inches broad, was burnt and hardened like leather, of a deep blackiſh red colour, very like the ſcorched ſkin of a roaſted pig: And on the forepart of the left ſhoulder, ſuch another ſpot of the bigneſs of a ſhilling. From the top of the right ſhoulder towards the ſcar on his breaſt, run a narrow line of the like ſcorched ſkin.

Moſt of the buttons of his doublet were torn off, its collar, both cloth and ſtiffening, ſeemed as if cut or chopt with a blunt tool. His hat was ſtrangely torn, on the ſide of it was a great hole, large enough to put ones fiſt through, and ſome parts of it were quite ſtruck away.

The night following, the three doctors and himſelf, with ſome ſurgeons, were preſent at the opening of the head; but there appeared no ſign of contuſion; the brain was full and in good plight, the nerves whole and ſound, the veſſels of the brain pretty full of blood. Some thought they diſcerned a fiſſure in

the ſkull, but it was ſo ſmall as not to be obſervable by candle-light.

Some of the hair on the right temple was manifeſtly ſinged, and the lower parts of that ear blacker than thoſe about it, but ſoft, which might be owing to the ſettling of the blood. The upper part of the left ſhoulder, and that ſide of the neck were ſomewhat blacker than the reſt of the body.

Upon opening the breaſt, the burning was found to reach quite through the ſkin, which in the ſcorched parts was hard, horny, and ſhrunk up; but no appearance of its reaching deeper than the ſkin. Upon removing the *Sternum*, the lungs and heart appeared ſound, well coloured, and without the leaſt diſorder.

Of Shining Fiſh, *by Dr.* Beal. Phil. Tranſ. N° 13. p. 226.

MAY 5th, 1665, freſh mackrel were boiled in water with ſalt, and ſweet herbs, and they were left in water for pickle. *May* 6th, more freſh mackrel were boiled; and *May* 7th, both water and mackrel were put into the former water, together with the former mackrel; but *May* 8th, in the evening, the cook, ſtirring the water to take out ſome of the mackrel, found the water become very luminous, and the fiſh ſhining through the water encreaſed its light. The water, by the mixture of ſalt and herbs in the boiling, was of itſelf thick, and rather blackiſh than of any other colour.

Wherever the drops of this water fell, after ſtirring, they emitted a light.

Upon the cook's turning up the loweſt ſide of the fiſh, there was no light; and after the water was ſettled and fully at reſt, it did not ſhine at all.

May 9th, the water, till it was ſtirred, yielded no light, but was thick and dark. As ſoon as the cook thruſt his hands into it, it began to glimmer; but being gently ſtirred round by the hand, it ſhone in ſuch a manner, that thoſe at a diſtance took it for the light of the moon ſhining through a window on a veſſel of milk, and by a briſker circulation it ſeemed to flame.

The fiſh at that time ſhone both from the inſide and outſide, and chiefly from the throat, and thoſe places that ſeemed a little broken in the boiling. He took a piece that ſhined moſt, and fitted it in the night, as well as he could, to his great Microſcope, and afterwards to his little one; but he could diſcern no light by any of theſe glaſſes, nor any from the drops of the ſhining water, when put into the glaſſes. And *May* 10th, in the brighteſt rays of the ſun, he examined, in his great microſcope, a ſmall broken

broken piece of the fiſh, which ſhined moſt the night before, and found nothing remarkable on the ſurface of the fiſh. It ſeemed whitiſh and in a manner dried, and with deep inequalities; and a ſteam, rather darkiſh than luminous, ſeemed to ariſe, like a fine duſt, from the fiſh: And here and there little imperceptible ſparkles. He affirms himſelf, certain of the ſparkles, their number, order, and place being agreed on both by himſelf and the ſpectators; of the ſteam he is not ſo confident.

The great microſcope being fitted by day-light for this piece of fiſh, he examined it that night, and it yielded no light at all, either by the glaſs or otherwiſe. Upon finding it dry, he thought the moiſture of ſpittle, and touching of it, might make it ſhine; which it did, though but little, in a few ſmall ſparkles, which ſoon died. This was obſerved with the naked eye.

He cauſed two fiſh to be kept two or three days longer, in very hot weather, till they became fœtid; and then he expected a greater brightneſs, but could obſerve none, either in the water, by ſtirring it, or in the fiſh, out of the water.

A Statical Baroſcope, *by Mr.* Boyle. Phil. Tranſ. N° 14. p. 231.

HE cauſed ſome glaſs bubbles to be blown by the flame of a lamp, as large, thin, and light as he could then procure; and chuſing one of the beſt, about the bigneſs of a large orange, and a dram and ten grains in weight, he counterpoiſed it in a pair of ſcales, that might be turned with the thirtieth part of a grain, ſuſpended on a frame. He placed both balance and frame by a good barometer, that he might learn the preſent weight of the atmoſphere: Though the ſcales could not ſhew him all the variations of the weight of the air exhibited by the mercurial barometer; yet they did what he expected, by ſhewing him variations that altered the height of the quickſilver half a quarter of an inch, and perhaps much ſmaller than thoſe; and he doubted not, if he had nicer ſcales, of being capable of perceiving far ſmaller alterations in the weight of the air, ſince he obſerved the bubble ſometimes in an æquilibrium with the counterpoiſe; and ſometimes when the atmoſphere was high, preponderate ſo plainly, that the ſcales being gently touched, the cock would play on that ſide, at which the bubble was hung; and at other times, when the air was heavier, that, which was at firſt the counterpoiſe only, would preponderate, and, upon the motion of the balance, make the cock vibrate altogether on its ſide; and this for many days together, if the air was equally heavy; and

on a change of weight, the bubble would regain either an æquilibrium or a preponderancy; ſo that by conſulting firſt the ſtatical baroſcope, he could foretel, whether the mercury were high or low in the barometer.

The principles, on which the conſtruction of this baroſcope is founded, are, 1. That though the glaſs bubble and braſs counterpoiſe, at the time of their firſt being weighed, be in the air, exactly of the ſame weight; yet they are far from being of the ſame bulk, the bubble being a hundred or two hundred times bigger than the metalline counterpoiſe. 2. That according to hydroſtatical laws, if two bodies of equal gravity, but unequal bulk, come to be weighed in another medium, they will no longer equiponderate; but if the new medium be heavier, the greater body, as being ſpecifically lighter, will loſe more of its weight than the leſs, and more compact; but if the new medium be lighter than the firſt, then the bigger body will out-weigh the leſſer: And this diſparity, ariſing from the change of mediums, will be ſo much the greater, by how much the inequality of the bulk is ſo. 3. Comparing theſe two together, he conſidered that it would be all one, as to the effect, whether the bodies were weighed in mediums of different gravity, or in the ſame medium, in caſe its ſpecific gravity were ſubject to conſiderable alterations.

Though a ſingle bubble, of competent bigneſs, be much more preferable, becauſe leſs quantity and weight of glaſs is requiſite to compriſe an equal capacity, when it is blown into a ſingle bubble, then when divided into two; yet, if the balance be ſufficiently ſtrong to bear ſo much glaſs, without being hurt, the uſing of two, or a greater number of large bubbles, may render the effect more conſpicuous, than if only a ſingle bubble, and that a good one; were employed.

This inſtrument may be much improved by the addition of ſeveral apparatus's.

1. An arch of a circle divided into 15 or 20 degrees, more or fewer, according to the goodneſs of the balance, may be fitted to its cheeks, that the cock pointing to theſe diviſions, may readily and without calculation ſhew the quantity of the angle, whereby, when the ſcales incline either way, the cock declines from the perpendicular, and the beam from its horizontal paralleliſm.

2. Inſtead of the ordinary counterpoiſe of braſs, one of gold may be employed, or at leaſt of lead, whereof the latter, being of the ſame weight with braſs, is leſs bulky, and the former amounts not to half its bigneſs.

3. Thoſe

3. Thoſe parts of the balance made of copper or braſs, will be leſs ſubject to ruſt than ſteel, which yet, if well hardened and poliſhed, may laſt a good while.

4. Inſtead of ſcales, the bubble may be hung at one end of the beam, and only a counterpoiſe to it at the other, that the beam may not be unneceſſarily loaded.

5. If the inſtrument be placed in a ſmall frame, like a ſquare lanthorn with glaſs windows, and a hole at the top for the air, it will be freer from duſt, and irregular joggings.

6. This inſtrument being furniſhed with a light wheel and an index, like that applied by Dr. *Wren* to weather-glaſſes, and Dr. *Hook* to baroſcopes, may be made to ſhew minuter variations, than otherwiſe.

7. The length of the beam, and exquiſiteneſs of the balance, may render the inſtrument ſtill more exact.

Though this ſtatical baroſcope be in ſome reſpects inferior to the mercurial, yet in others, it has its advantages.

1. It affords an ocular demonſtration, that the falling and riſing of the mercury depends on the variable weight of the atmoſphere; ſince here no *Fuga Vacui*, or an abhorrence of an empty ſpace or a *Funiculus*, can be pretended as the cauſe of the changes we obſerve. 2. It ſhews, that not only the air is heavy, but heavier than ſome philoſophers will allow; ſince even the variation of weight in ſo ſmall a quantity of air, as is equal in bulk to an orange, is manifeſtly diſcovered by ſuch balances. 3. This ſtatical baroſcope will often be more eaſily procured than the other. 4. It may alſo be conveyed from one place to another, without being ſpoiled in the carriage. 5. Mercurial barometers contain air in greater or leſſer quantities, whereas in the other, that conſideration has no place. 6. It being poſſible hydroſtatically to diſcover, both the bigneſs of the bubble, the contents of its cavity, and the weight and dimenſions of the glaſſy ſubſtance, we may eaſily find out the abſolute and relative weight of the air. For when the quickſilver, is either very high, or very low, or at a mean height, bringing the ſcale barometer to an æquilibrium, and obſerving when the mercury is fallen an inch or half an inch, *&c.* and putting the like minute diviſions of a grain to the lighter ſcale, till it equiponderate, you may determine what weight in the ſtatical baroſcope anſwers to the ſeveral heights of the mercury. And if the balance be fitted with a divided arch, or a wheel and index, you may readily determine, what the bubble has gained or loſt, by the change of the atmoſphere's weight.

7. By

7. By this ſtatical inſtrument we may be enabled to compare the mercurial baroſcopes of ſeveral places, and to make ſome eſtimates of the gravity of the air; as, if I find that the bubble weighed juſt a dram, when the mercurial cylinder was at the height of 29 $\frac{1}{2}$ inches, and that the addition of $\frac{1}{1}$ of a grain be requiſite to keep the bubble in æquilibrium, when the mercury is riſen $\frac{1}{8}$, *&c.* of an inch above the former height; and when in another place I find the mercury juſt at 29 $\frac{1}{2}$ inches, (ſuppoſing that barometer as free from air as mine), and the ſtatical baroſcope weigh preciſely a dram, the gravity of the atmoſphere in both theſe places, though ever ſo diſtant may be concluded equal; which we may alſo diſcover without any mercurial barometer, if an addition of weight be requiſite to be made to the bubble, to bring the ſcales to an æquilibrium. But in making theſe compariſons, we muſt conſider the ſituation of the ſeveral places, for if one of them be in a vale or bottom, and the other on the top of a hill, the weight of the atmoſphere in the latter place muſt be leſs than that of the former. And this ſuggeſts a method of finding the heights of mountains, *&c.* by obſerving the difference of the weight of the air at bottom and at top.

The Phaſes and Revolutions of Mars *about his Axis, by Dr.* Hook. Phil. Tranſ. N° 14. p. 239.

ON the third of *March* 166$\frac{5}{6}$, though the diſpoſition of the air was bad enough, yet he could diſcern now and then the body of *Mars* of the form A; and about 10 minutes after, it had the appearance B. This, he was ſufficiently ſatisfied, could be nothing more than ſome duſky and ſpotted parts of the face of this planet.

March 10th, finding the air very bad, he made uſe of a very ſhallow eye-glaſs, as finding nothing diſtinct, with a greater charge, and ſaw *Mars* as repreſented in C, which he imagined might be the appearance of the former ſpots by a leſs aperture. About three o'clock the ſame morning, the air being very foul, the body ſeemed like D; which he ſtill ſuppoſed to be the repreſentation of the ſame ſpots through a more confuſed and glaring air.

But *March* 21ſt, he was ſurprized to find the air ſo exceeding tranſparent, and the face of *Mars* ſo well defined, round, and diſtinct, that he could plainly ſee it of the ſhape in E, about half an hour after nine at night. The triangular ſpot, on the right ſide, appeared very black and diſtinct, the other, to the left, more dim; but both ſufficiently plain and defined. About a quar-

a quarter before 12 the ſame night, he obſerved it again with the ſame glaſs, and found the appearance exactly as in F; which he imagined to ſhew a motion of the former triangular ſpot.

But *March* 22d, about half an hour after eight at night, finding the ſame ſpots in the ſame ſituation as in G, he concluded, that the preceeding obſervation was only the appearance of the ſame ſpots at another height and thickneſs of the air, and this opinion was confirmed by finding them in the ſame ſituation *March* 23, about half an hour after nine, as in H.

March 28th, about three the air being light, though moiſt and a little hazy, he plainly ſaw it of the form in I, which is not reconcileable with the other appearances, unleſs we allow of a turbinated motion of *Mars* on its centre, which, from the obſervations made *March* 21ſt, 22d, and 23d, may happen once or twice in about 24 hours; unleſs it have ſome kind of libratory motion, which ſeems not very probable.

Obſervations made in *Italy* confirming the former, and fixing the period of the revolution of *Mars* by *Caſſini*.

With a teleſcope of about 16 feet, wrought after *Campani*'s way, *Caſſini* began to obſerve, *February* 6, 1666, N. S. in the morning, and he ſaw two dark ſpots in the firſt face of *Mars* repreſented by K. He obſerved with the ſame glaſs *Feb.* $\frac{14}{24}$ in the evening, two other ſpots, like thoſe of the firſt, but bigger, in the other face of this planet, as L. And afterwards continuing his obſervations, he found the ſpots of theſe two faces to revolve gradually from eaſt to weſt, and to return at laſt to the ſame ſituation, wherein he had ſeen them at firſt. S. *Campani* with glaſſes of 35 foot, of his own contrivance, obſerved the ſame phænomena, as in fig. M. Sometimes he ſaw in the ſame night the two faces of *Mars*, one in the evening, and the other in the morning, as in fig. M and N. The motion of theſe ſpots, in the inferior part of the apparent hemiſphere of *Mars*, is from eaſt to weſt, as that of all the other celeſtial bodies, and is performed by parallels that decline much from the equator, and little from the ecliptic. The ſpots returned the next day to the ſame ſituation, 40 minutes later than the day before, ſo that in 36 or 37 days, they return to the ſame place about the ſame hour.

S. *Caſſini* relates, that ſeveral obſervations of theſe ſpots of *Mars* were made at *Rome* by other aſtronomers, from *March* $\frac{14}{24}$ to *March* $\frac{20}{30}$, with glaſſes, wrought by *Euſtachio Divini*, of 15 and 30 foot. He adds that the other *Roman* aſtronomers, who obſerved with *Divini*'s glaſſes, will have the revolution of *Mars*

to

to be performed, not in 24 hours 40 minutes according to him, but in about 13 hours.

In order to evince the miſtake of theſe aſtronomers; he alledges, that they aſſure the ſpots they had ſeen of this planet, by an *Euſtachian* tube, the $\frac{28}{30}$ *March*, to be ſmall, very diſtant from each other, remote from the middle of the diſk, and the oriental ſpot leſs than the occidental one, as in fig. O, like the firſt face of *Mars*; whereas, on the contrary, *Caſſini* pretends to prove by his obſervations made at *Bologna*, that, the ſame day and hour, theſe ſpots were very large, near each other, in the middle of the diſk, and the oriental bigger than the occidental, as appears by fig. P, the ſecond face of *Mars*. Beſides, he declares, that theſe aſtronomers were too haſty, in determining after five or ſix obſervations only, the period of his revolution; and denies it to be performed in 13 hours: That he himſelf, after a ſeries of many obſervations, durſt not for a great while define whether *Mars* revolved in 24 hours 40 minutes, once or twice; and that all he could affirm, was, that after 24 hours 40 minutes, this planet appeared in the ſame manner it did before. But ſince theſe firſt obſervations, he affirms, he had reaſon to determine the period of its revolution to be once in 24 hours 40 minutes; alledging, that whereas *Feb.* 6th, N. S. he ſaw the ſpots of the firſt face of *Mars* moving from eleven at night till break of day; they appeared not afterwards in the evening, after the riſing of that planet; whence he infers, that after 12 hours 20 minutes, the ſame ſpots did not return; for ſuch as were ſeen in the morning in the middle, on the riſing of *Mars*, after 13 or 14 hours appeared near the occidental limb. So that he concludes the period of this planet's revolution to be performed not in 12 hours 40 minutes, but in about 24 hours 40 minutes. When S. *Caſſini* defines the time of the revolution, he does not ſpeak of its mean revolution, but of that only, which he obſerved, whilſt *Mars* was in oppoſition to the ſun; which is the ſhorteſt of all.

The Shadows *of* Jupiter's Satellites *obſerved by S.* Campani, *M.* Caſſini, *Mr.* Hook, and others. Phil. Tranſ. N° 14. p. 245, &c.

S. *Campani* affirms that he obſerved in the belts of *Jupiter*, the ſhadows of his ſatellites, and continuing his obſervations, he at length ſaw them emerge out of his diſk.

M. *Caſſini*, after he had diſcovered by *Campani*'s glaſſes of 35 foot, the ſhadows caſt by the ſatellites of *Jupiter* upon his diſk

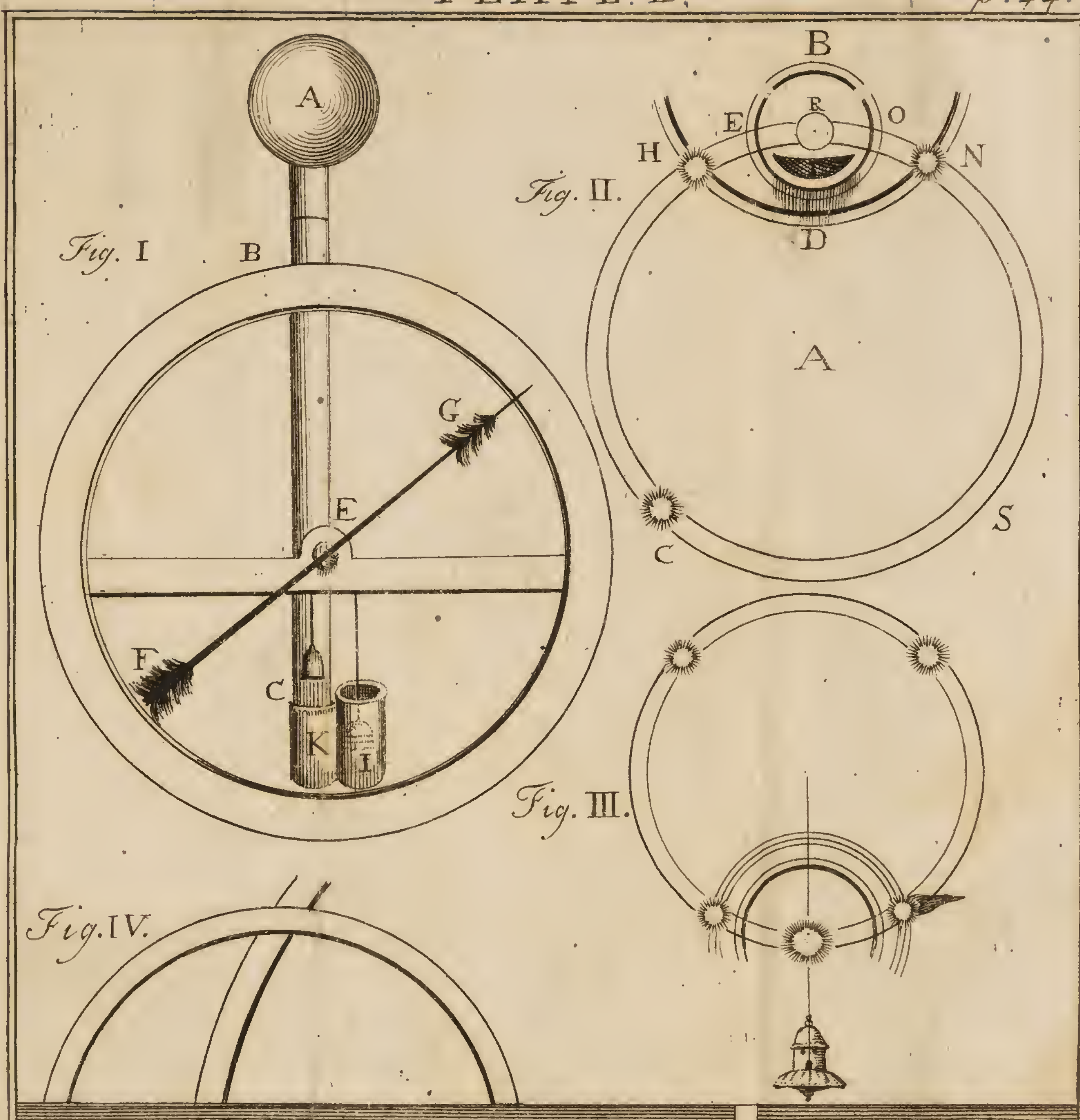
Fig. I
Fig. II.
Fig. III.
Fig. IV.
MARS.
Jupiter.
SATURN.
Hulsbergh Sculp.

diſk when they happen to be between the ſun and him, and after he had diſtinguiſhed their bodies upon the diſk of *Jupiter*, made ſome predictions when they ſhould appear, that the curious might be convinced of this matter by their own obſervations.

Some of theſe predictions have been verified not only at *Rome*, and other parts of *Italy*; but alſo at *Paris*, by M. *Auzout*, and in *Holland*, by M. *Huygens*, particularly, *Sept.* 26, 1665, at half an hour after ſeven o'clock, one of theſe ſhadows was ſeen both in *France* and *Holland*.

Theſe ſpots have this in peculiar, and which diſtinguiſhes them from all others, that they are found preciſely in that part of *Jupiter*, where ſome ſatellite is ſeen by the ſun; that they proceed from the oriental to the occidental limb of *Jupiter*'s diſk, with a motion always equal to that of the ſatellite; that with reſpect to us they precede the ſatellite, before *Jupiter*'s oppoſition to the ſun, and follow him, after it; that the greater *Jupiter*'s diſtance from the oppoſition is, the greater is the apparent diſtance of the ſame ſatellite; that at divers times of the year, this diſtance changes in proportion to the annual parallax of the ſatellite, according as he is differently ſeen from the ſun and the earth; and that at one and the ſame time of the year, when divers ſatellites happen to be between *Jupiter* and the ſun, the ſpots correſponding to them, are diſtant in proportion to the ſemidiameters of the circles of the ſame ſatellites.

Anno 1666, *January* 26, about 3 hours 15′ in the morning, Dr. *Hook* perceived with a 60 foot glaſs, near the middle of the belt or zone *d*, a very round ſpot, like that repreſented at *g*, which was not to be perceived about half an hour before; and he obſerved it in about 10′ time, to be got almoſt to *d*, keeping equal diſtance from the ſatellite *h*, which moved alſo weſtwards, and was joined to the diſk at *i*, at 3 hours 25′: So that it was ſufficiently plain, that this black ſpot was nothing more than the ſhadow of the ſatellite *h*, eclipſing a part of *Jupiter*'s face. The other three ſatellites, during this eclipſe, were weſtward of the body of *Jupiter*.

The Phaſes of Jupiter, *by Dr.* Hook. Phil. Tranſ. N° 14. p. 245.

ANNO 1666, *June* 26, between three and four in the morning, he obſerved the body of *Jupiter* through a 60 foot glaſs, and found its apparent diameter to be more than two degrees, that is about four times as big as the diameter of the moon appears to the naked eye.

He ſaw the limb pretty round, and pretty well defined without radiation, the parts of its phaſis had various degrees of light; about *a* and *f* its north and ſouth poles, it was ſomewhat darker, and gradually grew brighter towards *b* and *e* two zones or belts; one of which *b*, was a ſmall dark belt croſſing the body ſouthward, near which was a ſmall line of a ſomewhat brighter part, and below that again, ſouthwards, was the great black belt *c*. Between that and *e*, the other ſmaller black belt, was a pretty large and bright zone; but the middle *d*, was ſomewhat darker than the edges.

An Obſervation of Saturn, *by Mr.* Hook. Phil. Tranſ. N° 14. p. 246.

JUNE 29th, *1666*, between eleven and twelve at night, Dr. *Hook* obſerved the body of *Saturn* through a *60* foot teleſcope, and found it exactly of the ſhape repreſented in Fig. R. The ring appeared ſomewhat brighter than the body, and the black lines *a a* croſing the ring, and *b b* croſſing the body, were plainly viſible; whence he could plainly ſee, that the ſouthermoſt part of the ring was on this ſide of the body; and the northern part, behind, or covered by the body.

Of the Effect of Thunder *and* Lightning, *by* Tho. Neale, *Eſq*; Phil. Tranſ. N° 14. p. 247.

ON the 24th of *Jan.* 166⅚, one Mr. *Brooks* of *Hampſhire*, going from *Wincheſter* to *Andover* in very bad weather, was himſelf, and the horſe he rode on, killed by lightning. He was found about a mile from *Wincheſter*, with his face pitched in the earth, one leg in the ſtirrup, and the other on the horſe's mane; his cloaths were all burnt off his back, and not the leaſt piece left intire, and his hair and all his body were ſinged: His noſe was beaten into his face, and his chin into his breaſt, wherein was a wound reaching almoſt to his navel; his gloves were intire, but his hands burnt to the bone; his horſe's hip-bone and ſhoulder were ſcorched and bruiſed; and his ſaddle torn to pieces. This is what appeared to the coroner's inqueſt.

Cold *produced with* Sal-armoniac, *by Mr.* Boyle. Phil. Tranſ. N° 15. p. 255.

THE moſt plain and eaſy method of making cold mixtures with ſal-armoniac, is as follows: Take a pound of powdered ſal-armoniac, and about three pints of water, put the ſalt into it, either at once, if you deſign to produce an intenſe but ſhort

ſhort cold, or at ſeveral times, if only a more laſting, rather than great degree of it; ſtir the powder in the water with a ſtick, or whale bone, to promote its ſolution; for on the quickneſs of that, depends the intenſeneſs of the cold.

That a conſiderable degree of cold is really produced by this operation, is very plain, firſt, by feeling; ſecondly, by this, that if the experiment be made in a glaſs body or a tankard, you may obſerve, that during the ſolution, the outſide of the veſſel will, as high as the mixture, be bedewed with a number of little drops of water; as it happens, when mixtures of ſnow and ſalt, being put into glaſſes or other veſſels, the aqueous vapours, that float in the air near the ſides of theſe veſſels, are by cold condenſed into water; thirdly, the beſt and ſureſt way of finding the degree of cold, is by plunging into it a good ſealed thermometer with tinged ſpirit of wine; for on putting the ball into this mixture, the ſpirit will deſcend much lower than in the open air, or in common water of the ſame temperature with that in which the ſalt was diſſolved; and if you remove the glaſs out of the mixture into common water, the tinged ſpirit will re-aſcend, which was alſo the caſe when put into water newly impregnated with ſalt-petre.

This cold in ſummer and hot weather ſoon decays; but if the quantity of ſalt and water be conſiderable, it will be both more laſting and more intenſe, and the different goodneſs of the ſalt contributes likewiſe its ſhare to the producing this effect, as the honourable Mr. *Boyle* experienced. The duration of this cold may alſo depend on the way of putting the ſalt into the water; for if it is thrown in all at once, the water will ſooner acquire an intenſe degree of cold, but ſo much the ſooner will it return to its former temperature; but if you put the ſalt in by little and little, the cold will laſt longer, though it be not ſo intenſe, and conſequently, will be fitteſt for cooling of liquors. When the tinged liquor ſubſided ſlowly, or was at a ſtand, by putting, at times, two or three ſpoonfuls more of ſalt, and ſtirring the water to promote the ſolution, the ſpirit of wine would begin again to deſcend, if it were at a ſtand, or riſing; or ſubſide much more ſwiftly than before. And if you would protract the experiment, let ſome of the ſal-armoniac be groſly pounded, that it may be the longer in diſſolving and conſequently cooling the water. He found, in the ſpring, a ſenſible adventitious cold, produced by a pound of ſal-armoniac, to laſt above two or three hours.

G 2 Put

Put the liquors you deſign to cool into thin glaſſes, with their orifices ſtopt; and ſtill kept above the mixture, moving them in it to and fro, and then pour out the liquors to be drank; one may readily cool his hands by applying them to the outſide of the veſſel that contains the mixture; and pieces of cryſtal or bullets, for cooling the mouths and hands of patients, may be powerfully refrigerated; for cooling of air and liquors, for adjuſting weather-glaſſes, or imparting to a ſmall quantity of beer, *&c.* a moderate degree of coolneſs, leſs than a whole pound of ſal-armoniac may be ſufficient; for, you may obſerve by a ſealed weather-glaſs, that a few ounces, well powdered and nimbly diſſolved in about four times its weight of water, will anſwer well enough for many purpoſes.

In confirmation of all this, the honourable Mr. *Boyle* ſubjoins a few experiments, after firſt premiſing an account of the ſealed thermometer, wherewith the obſervations were made, *viz.* That the length of the cylindrical tube was 16 inches, the ball about the bigneſs of a large walnut, and the bore of the tube about $\frac{1}{8}$ or $\frac{1}{9}$ of an inch in diameter.

March 27th, Upon firſt putting the weather-glaſs into the water, the tinged ſpirit remained at 8 $\frac{1}{8}$ inches, but continuing there a good while, and at intervals moving it up and down in the water, it deſcended a little below 7 $\frac{1}{8}$ inches; then throwing in the ſal-armoniac; in about a quarter of an hour or leſs, it fell to 2 $\frac{1}{16}$ inches; but before that, it began to freeze the vapours on the outſide of the glaſs: And when the frigorific power was arrived at its height, he found that water, thinly laid on the outſide, on ſtirring the mixture nimbly, would freeze in a quarter of a minute. About $\frac{3}{4}$ of an hour, after the freezing body was put in, the thermometer, that had been taken out a while before, and was riſen to the loweſt freezing point, being put in again, fell an inch below it; about 2 $\frac{1}{2}$ hours from the firſt ſolution of the ſalt, the tinged liquor ſtood in the middle between the freezing points; one of which was at 5 $\frac{1}{2}$ inches, (at which height, it would uſually be froſty abroad) and the other at 4 $\frac{3}{4}$ inches, the height at which the liquor ſtood in ſtrong and laſting froſts in winter: In three hours after the beginning of the obſervation, he found the liquor higher than the upper freezing point abovementioned; after which it continued to riſe very ſlowly for about an hour longer. This mixture being made in a glaſs body, with a large and flat bottom, a little water ſpilt on the table, was froze ſo ſtrong, that it faſtened the glaſs to the table, and

the ice in ſome places was about the thickneſs of a half crown. He made another obſervation the ſame ſpring, to ſhew the duration of cold; for the firſt time the ſealed weather-glaſs was put in, before it touched the common water, it ſtood at $8\frac{1}{8}$, being left there a conſiderable while, and once or twice ſtirring the water, the tinged liquor ſubſided only to $7\frac{1}{8}$, or at moſt $7\frac{6}{8}$; then the frigorific liquor being put into the water, in about half a quarter of an hour, the liquor fell beneath $3\frac{3}{4}$; and the thermometer, being taken out, and then put in again, an hour after the water had been firſt frozen, ſubſided beneath 5 inches, and conſequently within $\frac{1}{4}$ of an inch of the point of ſtrongly freezing weather.

An Hypotheſis of the Tides, *by Dr.* Wallis. Phil. Tranſ. N° 16. p. 263.

THE tides are obſerved to be ſo connected with the motion of the moon, that it is reaſonable to conclude, that either the one is influenced by the other, or at leaſt, that both ariſe from ſome common cauſe.

Some philoſophers aſcribed this effect to an occult quality, or particular influence, the moon exerts on moiſt bodies; others to a magnetic virtue, whereby the waters are attracted towards it, ſo as to cauſe high water in that place, wherein the moon is vertical; others again to its gravitation or preſſure downwards upon the terraqueous globe, whereby it produces loweſt water, where vertical. But the firſt, who took in the conſideration of the diurnal and annual motion of the earth to ſolve this phænomenon, was *Galileo*, in his *Syſtem of the World*.

There are three things obſervable in Tides. Firſt, the diurnal reciprocation, whereby, in little more than 24 hours, we have twice a flood and an ebb. Secondly, the menſtrual; whereby in one ſynodical period of the moon, or from one conjunction to another, the hour of thoſe tides ſhifts through the whole compaſs of the natural day of 24 hours; *e. gr.* if at full moon, it be full ſea at any place, juſt at noon, the day following, it will be a little before one, at the ſame place; the day after that, between one and two, *&c.* till at new moon it happen at midnight, and the next full moon bring it back again to noon. The ſpring tides, which are thoſe at full and new moon, are the higheſt; the neap-tides, at the quadratures, are the loweſt, and at intermediate times the tides are proportionable. Thirdly, the annual reciprocation, when it is obſerved, that at ſome ſeaſons of the year, the ſpring-tides

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are higher than thoſe at other times, uſually thought to be in ſpring and autumn, or at the two equinoxes.

To account for theſe three periods according to the laws of motion, and mechanic principles; we may take for granted, that a body in motion is apt to continue its motion, and that in the ſame degree of celerity, unleſs hindered by ſome impediment; and that a body at reſt, will continue in that ſtate, unleſs put into motion by ſome ſufficient mover. To explain this further, *Galileo* inſtances in a broad veſſel of water, for ſome time evenly carried forward with the water in it, upon ſtopping of which, the water will daſh forward, and riſe higher at the fore-part of the veſſel: And on the contrary, if the veſſel be thruſt forward faſter than before, the water will daſh backwards, and riſe at the hinder part of the veſſel. So that an acceleration or retardation of the veſſel, which carries it, will cauſe a riſing in one part, and a falling of water in another, which yet by its own weight returns to its former level. And conſequently, ſuppoſing the ſea a looſe body carried about with the earth, but not ſo united to it, as neceſſarily to receive the ſame degree of impetus with it, as its fixt parts do; the acceleration or retardation in the motion of this or that part of the earth, will cauſe, proportionably, ſuch a daſhing of the water, or riſing at one part, with a falling at another, analagous to what we call the flux and reflux of the ſea.

Next, we are to ſuppoſe with *Galileo* a double motion in the earth, the one annual in the great orbit, in which the centre of the earth is ſuppoſed to move about the ſun; the other diurnal, whereby the whole moves on its own axis, and each point in its ſurface deſcribes a circle.

It is plain, that if the earth were moved with any one of theſe motions, with an equal ſwiftneſs, the water would hold pace with it; but the true motion of each part of the earth's ſurface being compounded of the annual and diurnal, and the former, according to *Galileo*, being triple the latter, in a great circle; the diurnal motion, in that part of the earth next the ſun, diminiſhes the annual, and moſt of all at noon; and in the other increaſes it, and moſt of all, at midnight; which affords us a cauſe of two tides in 24 hours; the one, on the greateſt acceleration of motion, the other, on its greateſt retardation.

So far *Galileo*'s hypotheſis ſeems to hold well enough; but falls ſhort, as it accounts only for two tides always at noon and midnight,

midnight, contrary to experience, ſince they ſhift in a whole month through all the 24 hours. To obviate this difficulty, *John Baptiſta Balianus* makes the earth a ſecondary planet only, and not to move directly about the ſun, but the moon; this latter mean while revolving about the ſun. But though this might furniſh us with a menſtrual period of accelerations and retardations in the compound motion of the ſeveral parts of the earth's ſurface, yet, it cannot be admitted as a true hypotheſis, and conſequently, the menſtrual period of the tides cannot be ſolved by ſuch a ſuppoſition.

Inſtead of this, Dr. *Wallis*'s ſurmiſe is, for he owns, he dare not give it a better name, that the earth and moon being bodies ſo greatly connected, whether by magnetiſm or any other tie, he will not determine, as that the motion of the one follows that of the other; the moon obſerving the earth as the centre of its periodic motion; and therefore they may be conſidered as one body, or rather one aggregate of bodies, with one common centre of gravity; which centre, according to the known laws of ſtatics, is in a ſtraight line connecting their reſpective centers, ſo divided, as that its parts be in reciprocal proportion to the gravities of the two bodies. As for example, ſuppoſe the magnitude, and therefore, probably the gravity of the moon, to be about $\frac{1}{40}$ of that of the earth; and the diſtance of the moon's centre from that of the earth, to be about 56 ſemi-diameters of the earth; the diſtance of the common centre of gravity of theſe two bodies, from that of the earth, will be about $\frac{1}{42}$ of 56 ſemidiameters; *i. e.* about $\frac{56}{42}$ or $\frac{4}{3}$ or $1\frac{1}{3}$ of a ſemidiameter of the earth, and poſited above its ſurface in the air, directly between the earth and moon.

Now, ſuppoſing the earth and moon, as one body carried about the ſun in the great orbit; this motion, according to the laws of ſtatics, is to be eſtimated by that of the common centre of gravity; and conſequently the line of the annual motion, will be deſcribed by the common centre of gravity of the two bodies, the earth and moon, being as one aggregate.

According to this ſuppoſition, the menſtrual motion from laſt to firſt quarter accelerates the annual motion, and moſt of all at new moon; and from the firſt to the laſt quarter, it retards the annual motion, and moſt of all at full moon; ſo that in purſuance to *Gallileo*'s notion, the menſtrual addition to, or ſubtraction from the annual motion, ſhould either leave behind, or throw the waters forward on the earth; and moſt of all, at full and new moon, when theſe accelerations and retardations

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are greateſt. Now, this menſtrual motion, if nothing elſe were ſuperadded to the annual, would give us two tides a month, and no more, *viz.* at new and full moon, the one upon the acceleration, and the other at the retardation; and two ebbs, at the two quarters; and in the intervals, riſing and falling water. But, by ſuperadding the diurnal motion, it has the ſame effect on the menſtrual, that *Galileo* ſuppoſes it to have on the annual, that is, to add to, or ſubſtract from the menſtrual acceleration or retardation; and ſo give tide after tide. The greateſt acceleration or retardation, given by the diurnal arch to the menſtrual, is when the moon is in the meridian, either above or below the horizon; and this ſeems to be the true cauſe of the daily tides; and why in a month they ſhould ſhift through the whole 24 hours, becauſe the moon's coming to the meridian above and below the horizon, or, in the ſea phraſe, the moon's ſouthing and northing, does ſo; and this alſo ſeems to account for the ſpring and neap-tides: For when the menſtrual and diurnal accelerations and retardations coincide, as at new and full moon, the effect muſt needs be the greater. And although (which is not to be diſſembled) this happen but to one of the two tides; that is, the night tide at the new moon, when both motions do moſt of all accelerate, and the day-tide at full moon, when both do moſt retard the annual motion; yet this tide being thus raiſed by two concuring cauſes, though the next tide have not the ſame cauſe alſo, yet the impetus contracted will influence the next tide; juſt as a pendulum let fall from a higher arch, will, though there be no new cauſe, make the vibration on the other ſide, beyond the perpendicular, to be alſo greater. But here we are to obſerve, that though all parts of the earth, by its diurnal motion, revolve about its axis, and deſcribe parallel circles; yet not equal ones, but greater near the equinoctial, and leſs, near the poles, which may cauſe the tides to be much greater in ſome parts than in others: But this belongs to the particular conſideration of tides, of which we are not now giving an account, and not to the general hypotheſis.

After explaining the diurnal and menſtrual periods of tides, he proceeds to the annual; as to which, there is, at leaſt, this much agreed; that at ſome times of the year, the tides are obſerved to be higher than at other times: And firſt, he rectifies the time of the obſervation, and then accounts for it: As to the firſt; it having been groſly obſerved, that theſe high tides uſually happen about the ſpring and autumn, and that the

two

two equinoxes are the proper times, to which theſe annual high tides are to be referred; to this the doctor oppoſes, that having had frequent occaſion for 20 years to converſe with ſome inhabitants of *Romney-marſh* in *Kent*, where the ſea is kept out with great earthen banks, that it might not overflow the level; they generally agreed in informing him, that their times of danger were about the beginning of *February* and *November*; that is, at thoſe ſpring tides which happen near theſe times; and which they call *Candlemas-ſtream* and *All-hollond-ſtream:* And if they eſcaped theſe ſpring tides, they thought themſelves out of danger for the reſt of the year: As for the two equinoxes, *March* and *September*, they were as little ſolicitous about them, as any other ſeaſon of the year. And ſince that time, he himſelf frequently obſerved, both at *London* and elſewhere, that in thoſe months of *February* and *November*, eſpecially the latter, the tides run higher than at other times. This effect he aſcribes to the inequality of the natural day of 24 hours, which increaſes by ſo much as anſwers to that part of the ſun's annual motion run over in that time, and this inequality again ariſes from a double cauſe, *viz.* 1. Becauſe the ſun on account of its apogæum and perigæum or greateſt and leaſt diſtance from the earth, does not at all times of the year diſpatch in one day an equal arch of the ecliptic; but greater arches near the perigæum, which is about the middle of *December*; and leſs, near the apogæum, about the middle of *June*. 2. Though the ſun in the ecliptic ſhould always move at the ſame rate; yet equal arches of the ecliptic correſpond not to equal arches of the equinoctial, by which we are to eſtimate time: Becauſe ſome parts of it, as about the two ſolſticial points, lie nearer to a parallel poſition of the equinoctial than others, as thoſe about the two equinoctial points; wherefore an arch of the ecliptic near the ſolſticial points anſwers to a greater arch of the equator, than an equal arch near the equinoctial points.

According to the firſt of theſe cauſes, we ſhould have the longeſt natural days in *December*, and the ſhorteſt in *June*, which operating ſeperately, would give us at thoſe times two annual high waters: According to the ſecond cauſe, if operating ſingly, we ſhould have the two longeſt days at the two ſolſtices in *June* and *December*, and the two ſhorteſt at the equinoxes in *March* and *September*; cauſing at thoſe times four annual high waters. But the true inequality of the natural days ariſes from a complication of theſe two cauſes, ſometimes oppoſing

and ſometimes promoting each other; the longeſt and ſhorteſt natural days of the whole year, are about *Allhollond* and *Candlemas*-tide, about which time, theſe annual high tides are obſerved: And therefore, we may reaſonably aſcribe this annual period to that cauſe, or rather complication of cauſes; for by this inequality of natural days, a phyſical acceleration and retardation of the earth's mean motion will ariſe, and conſequently a caſting of the waters backward or forward; either of which, will cauſe an accumulation or high water.

He adds, that making the daily tides to be at all places, when the moon is in their meridian, muſt be underſtood of open ſeas, where the water has free ſcope for its motions; for in bays and inland channels, the poſition of the banks and other cauſes muſt needs make the times different from what we ſuppoſe in the open ſeas; and that even in open ſeas themſelves, iſlands, currents, and ſhallows may alſo have ſome influence on them.

It may be objected, that if the earth ſhould thus deſcribe an epicycle about the common centre of gravity, it would, by this change of place, diſturb the celeſtial motions, and make the apparent places of ſome of the planets, different from what they would otherwiſe be: He anſwers, that this has been obſerved to be the caſe, and that aſtronomers have been very much puzzled to account for it, and that it is ſo far from being an objection againſt the doctrine, that this conſideration of the common centre of gravity, ſeems the only method of accounting for theſe inequalities of the celeſtial motions.

To this doctrine of Dr. *Wallis*, ſeveral objections were made; and firſt, it appears not, how two bodies, that have no tie, can have one common centre of gravity: To which it is anſwered, that it is harder to ſhew how they have, than that they have it; the load-ſtone and iron have ſomewhat equivalent to a tie, though inviſible, yet we know it by the effects; for two load-ſtones at once applied in different poſitions to the ſame needle, will attract it not directly to either, but to ſome intermediate point, which, as to theſe two, is the common centre of attraction; and it is the ſame thing as if ſome one loadſtone were in that point. Yet theſe two loadſtones, have no connexion or tie, though a common centre of virtue, according to which they jointly act; juſt ſo the earth and moon are connected by their common centre of gravity, though we ſee not the tie.

Second

Second objection, that at *Chatham* and in the *Thames*, the annual ſpring tides are obſerved to happen about the equinoxes, and not, according to this hypotheſis, about the beginning of *February* and *November*. Anſwer, if the meaning be, that annual high tides do then fall out, it is eaſy to perceive, that this depends on the obliquity of the ecliptic, the parts of the equinoctial anſwering to equal portions of the ecliptic, being near the ſolſticial points greateſt, and near the equinoctial leaſt of all: And this, he thinks, is ſo far from being inconſiſtent with his hypotheſis, that he both allows and aſſerts it, and beſides admits of another annual viciſſitude, anſwering to the ſun's apogæum and perigæum; and from theſe two cauſes co-operating near the times he mentions, the greateſt tides of all will be found to ariſe. As to the obſervations at *Chatham* and in the *Thames*, contrary to what he aſſerts to happen at *Romney-marſh*, theſe, he ſays, muſt be referred to further inquiry.

Third objection, that ſuppoſing the earth and moon to move about a common centre of gravity, if the higheſt tides be at the new moon, when neareſt the ſun and moſt diſtant from the earth, and the compound motion the ſwifteſt; and the tides abate as the earth approaches nearer; it may be aſked why they do not ſtill abate in proportion to the earth's approach, and the decreaſed ſwiftneſs of the compound motion: And why we have not ſpring-tides at the new moon, when the motion is ſwifteſt, and neap-tides at full moon, when ſloweſt, but ſpring-tides at both? This has been already accounted for in the hypotheſis; becauſe the effect indifferently follows, either upon a ſudden acceleration or retardation: Now theſe two happening, the one at new, the other at full moon, cauſe high tides at both.

Fourth objection, that the higheſt tides are not at all places about new and full moon, and particularly, that in ſome places of the *Eaſt-Indies*, the higheſt tides are at the quadratures: The anſwer in general is, that he pretends not to give a ſatiſfactory account of the particular varieties of tides in different parts of the world, for want of a competent hiſtory of them; for the various poſitions of channels, bays, promontories, gulphs, ſhallows, currents, trade-winds, &c. muſt affect very much the tides in ſeveral places.

Fifth objection, that the ſpring-tides happen not with us juſt at full and change, but two or three days after: Anſwer, it muſt be known whether this happen in open ſeas or in channels; for if in the latter, we muſt then account for them from

the particular ſituation of theſe places: But if it generally ſo happen in the wide open ſeas, the reaſon muſt be ſought for from the general hypotheſis; and till the matter of fact be aſcertained, no ſolution of this difficulty can be offered; but the doctor, ſuſpecting that it might be ſome days after, as well in the open ſeas, as in our narrower channels, choſe to ſay, *about* new and full, rather then *at* new and full: The truth is, the riſing and falling of water, from the jogging of it in a veſſel, is generally diſcernible ſome time after.

An Eclipſe *of the* Sun, June 22, 1666, *at* London; *by Mr.* Willoughby, *Dr.* Pope, *Dr.* Hook, *and Mr.* Philips. Phil. Tranſ. N° 17. p. 295.

The Eclipſe began at 5 h. 43′.

		h. m.		h. m.
It was darkened	$\frac{3}{11}$ Diam. - - at	6. 00.	5 dig. - - - - - at	7. 6.
	4 dig. - - - - -	6. 7.	4 dig. - - - - - -	7. 13.
	5 dig. - - - - -	6. 13.	3 dig. - - - - - -	7. 20.
	6 dig. - - - - -	6. 21.	2 dig. - - - - - -	7. 26.
	7 dig. - - - - -	6. 39 $\frac{1}{2}$.	1 dig. - - - - - -	7. 32.
	6 dig. - - - - -	6. 57.	0 dig. - - - - - -	7. 37.

Its duration hence appears to have been 1 h. 54′, its greateſt obſcurity a little more than 7 digits: About the middle, between the perpendicular and weſtward horizontal radius of the ſun; viewing it through Mr. *Boyle*'s 60 foot teleſcope, there was perceived a little of the limb of the moon without the ſun's diſk, which ſeemed to ſome of the obſervers to be ſome ſhining atmoſphere, about the body either of the ſun or moon. The figure of this eclipſe was obſerved, and the digits meaſured by caſting the figure through a five foot teleſcope on an extended paper, fixt at a certain diſtance from the eye-glaſs; and all the diameters of this round figure were divided by ſix concentric circles into 12 digits.

The obſervations made at *Madrid* by his excellence the earl of *Sandwich* are as follow:

The eclipſe began at *Madrid* about five in the morning, at 5 h. 15′. the ſun's altitude was 6 deg. 53′.

The middle of it was at 6 h. 2′. The ſun's altitude 15°. 5′.

The end was exactly at 7 h. 5′. The ſun's altitude 25°. 24′.

The duration 1 h. 50′.

Thirty-ſeven parts of the ſun's diameter remained light, and 63 were darkened.

The

The obſervations made at *Paris* by M. *Payen*, are theſe: The eclipſe began there, at 5 h. 44′. 52″. *mane.* It ended at 7 h. 43′. 6″. ſo that its whole duration was 1 h. 58′. 14″. The greateſt obſcuration was 7 dig. 50 m. but it ſeemed to be greater by 3 m. which M. *Payen* imputes to a particular motion of libration of the ſun's globe, whereby the ſame phaſes continued for 8 m. and ſome ſeconds, as if that luminary were ſtopt in its courſe, and this is rather to be ſuppoſed than a tremulous motion of the atmoſphere, according to *Scheiner.* The apparent diameters were almoſt equal; for in the phaſis of 6 digits, the circumference of the moon's diſk paſſed through the center of that of the ſun, in ſuch a manner that two lines drawn through the two horns of the ſun, made with the common ſemidiameter two equilateral triangles. The beginning and middle of the eclipſe was in the north-eaſt hemiſphere, and the end in the ſouth-eaſt. The firſt contact of the two diſks was obſerved in the ſuperior limb of the ſun's diſk, with regard to the vertical line; and in the inferior, with reſpect to the ecliptic: But the middle and the end were ſeen in the ſuperior limb, in regard both to the vertical and ecliptic; and what ſeemed extraordinary to this gentleman, both beginning and end of this eclipſe happened in the oriental part of the ſun's diſk.

Conſiderations and Enquiries concerning Tides, *by Sir* Robert Moray. Phil. Tranſ. N° 17. p. 298.

TIDES are obſerved to encreaſe and decreaſe regularly at different ſeaſons, according to the moon's age, in ſuch a manner, that about new and full moon, or in two or three days after, they are at the higheſt; and about the quarter-moons, at the loweſt; the former being called ſpring, and the latter neap-tides; the higheſt tides are alſo obſerved to have the loweſt ebbs, and their increaſes from the neap to ſpring-tides to be made in the proportion of ſines; the firſt increaſe exceeding the loweſt in a ſmall proportion; the next, in a greater; the third in a greater ſtill; and ſo on, to the middlemoſt, whoſe exceſs is greateſt of all; and again, they diminiſh from that, to the higheſt ſpring-tide; ſo that the proportions before and after the middle do greatly correſpond to each other, or ſeem ſo to do. The increaſe and decreaſe of the velocity of ebbings and flowings are alſo ſuppoſed to be in the proportion of ſines; though this proportion ſeems not to hold exactly, becauſe of the inequalities in the periods of the tides; for the time between one new moon and another being unequal, the moon's

moon's return to the ſame meridian not being always performed in the ſame time, there muſt be a like variation in the velocity of the tides, and in their riſing and falling: The number of tides from one new moon to another are ſometimes 57, ſometimes 58; and ſometimes 59, without any fixt order, which is another proof of the difficulty of reducing this matter to any great exactneſs. Yet, becauſe it is of great importance, it were to be wiſhed that obſervations were made for months, and even years together: For which end a fit apparatus might be made about *Briſtol* or *Cheapſtow*, becauſe the tides are ſaid to riſe thereabouts to 10 or 12 fathoms, and on ſome convenient place as a wall, rock, or bridge, an obſervatory may be built, and as near as can be to the brink of the ſea; and if it cannot be conveniently ſituated juſt at low water, there may be a channel cut from the low water to the bottom of the wall, rock, *&c.* This obſervatory is to be raiſed 18 or 20 foot above high-water, and a pump to be placed perpendicularly by the wall, reaching above high-water a convenient height. To the top of the pump a pulley is to be faſtened, for letting down into it a piece of floating wood, which, as the water comes in, may riſe or fall with it: And becauſe the riſing and falling of the water amounts to 60 or 70 foot, the counterpoiſe of the weight, that goes into the pump, is to hang upon as many pulleys, as may ſerve to make it riſe and fall within that ſpace, which is equal the height of the pump above that of the water: And becauſe the counterpoiſe will riſe and fall more ſlowly, and conſequently, in leſs proportions, than the weight itſelf; the firſt pulley may be fitted with a wheel or two, to turn the indexes in any proportion required, ſo as to exhibit the degrees of motion and thoſe of riſing and falling of the water; and this may be done with pendulum watches, that ſhew minutes and ſeconds. To prevent the weight's riſing and falling with an undulation, it will be proper, that the hole, whereby the water enters, be only about half as big as the bore of the pump.

The particular obſervations to be made, are as follow:

1. The degrees of the riſing and falling of the water every quarter of an hour, or as often as may be, from the periods of the tides and ebbs; and that for two or three months every night and day.

2. The degrees of the velocity of the motion of the water, every quarter of an hour, for whole tides together; to be obſerved by a ſecond-pendulum-watch; and a log faſtened to a line of 50 fathoms wound about a wheel.

3. Exact

3. Exact meaſures of the heights of the greateſt high water and low water, from one ſpring-tide to another, for ſome months or rather years.

4. The exact height of ſpring-tides and ſpring-ebbs for ſome years together.

5. The direction of the wind at every obſervation of the tides, the times of its changes, and the degrees of its ſtrength.

6. The ſtate of the weather, as to rain, hail, miſt, hazineſs, *&c.* and the times of its changes.

7. At the times of obſerving the tides, the height of the thermometer, barometer, and hygrometer, the age of the moon, her azimuths and place, together with that of the ſun, are to be taken exactly.

The Parenchymous *Parts of the Body, by Sir* Edm. King. Phil. Tranſ. N° 18. p. 316.

THE *parenchymous* parts of the body, are by anatomiſts ſuppoſed to be ſuch as are wholly void of veſſels, deſigned chiefly to fill up the cavities and interſtices between the veſſels, to bolſter them up, and convey them through the parts of the body. But after ſeveral diſſections, and a careful examination of thoſe parts called *parenchymous*, as the liver, ſpleen, kidneys, *&c.* he found them full of veſſels. Further, he obſerved, that upon extending a piece of muſcular fleſh, either raw, roaſted, or boiled, he could perceive it full of veſſels as thick as they could lie; and that if any one take a muſcle, and begin either at the head or tail, he may divide it *in infinitum*; and compreſſing it, he may ſqueeze out a juice at either end; but if both ends are compreſſed, it will ſwell in the middle: Further, if any of theſe parts called *parenchymous*, be prickt with a needle, if this puncture be felt, it ſhews ſome nerve or fibrilla has been touched; and blood or ſome other liquor will follow the needle; and whence can this come but from veſſels? To confirm all this, he would have the following familiar obſervations conſidered.

1. If a horſe fat and full be rid extreme hard, and put into a great ſweat, and then kept for one day without water or moiſt meat, you will obſerve him look ſo thin, eſpecially in the muſcular parts, as hardly to take him for the ſame horſe, which can be owing to nothing elſe than a too great expence of the blood, wherewith his veſſels were ſtuffed.

2. He adds that he had been informed by graſiers, that if they buy any old beaſts, either oxen or cows, to feed, they are ſure to chooſe the pooreſt, ſo they be ſound; for ſuch feed not only very

kindly,

kindly, become very fat, but ſpend well, like young ones, and eat very tender. And the reaſon ſeems to be, that in ſuch a lean animal, the veſſels deſigned for admitting and diſtributing the nouriſhing juice, are ſo near contracted, and lie ſo cloſe together, that when once they are relaxed by freſh and unctuous nouriſhment, they extend every way, until in a little time, by the force of an extream extenſion, all the parts, fitted for the admiſſion of nouriſhment, become ſo thin and fine, that the lean beaſt put into a rich paſture, will eat young and tender; whereas one of the ſame age, that never was very poor, fed in the ſame paſture, will eat hard and tough. But if there were ſuch a thing as a *parenchyma*, that certainly would, like a ſpunge, immediately ſwell up in ſeveral parts, and more viſibly in thoſe parts that are moſt porous, to the great inconvenience of the parts, wherein it is ſeated; which yet he could never find in any muſcle.

3. It has been obſerved that corpulent perſons, fall away extremely in ſome diſeaſes. Which muſt be owing to a great conſumption of the ſtock of fluids, that in health kept the veſſels turgid.

Reflections on Petrification, *and a* Stone *taken out of the Womb of a Woman.* Phil. Tranſ. N° 18. p. 320.

A Complete hiſtory of petrification and the knowledge of the procedure of nature in that operation, is of conſiderable moment; for if it lay in the power of human ſkill to cauſe petrifactions, to order and direct the proceſs thereof, ſuch an art might become very uſeful, eſpecially if applied to prevent the generation of the ſtone and gravel in human bodies, or to diſſolve the ſame when already formed.

The ſecond head of the title is from Dr. *Beal*, who gives an account of a ſtone by inciſion, lately taken out of the womb of a woman, near *Trent* in *Somerſetſhire*, viz. *Eaſter* 1666, and was afterwards perfectly cured, though ſhe had borne the ſtone with extreme pain for eight or nine years: He himſelf ſaw the ſtone, and weighed it in very curious ſcales, being ſomewhat ſhort of four ounces; but it loſt ſome of its former weight, for it ſeemed too light for a ſtone of that bulk; it was of a whitiſh colour, lighter than aſh-colour, without any roughneſs, and of an oval figure, ſmaller at one end than a hen's egg, and bigger and blunter at the other than that of a gooſe.

Of

Of Worms *that eat Stone and Mortar, by M.* de la Voye. Phil. Tranſ. N° 18. p. 321.

IN a large and very ancient wall of free ſtone in the *Benedictin* abbey of *Caen* in *Normandy*, facing the ſouth, are found many ſtones ſo worm-eaten, that one may run his hand into moſt of the cavities; in theſe cavities are numbers of live worms, with their excrements, and a great deal of the ſtone-duſt they eat: He put ſome of the worms, with bits of the ſtone, for eight days into a box, and upon opening it, the ſtone was ſo ſenſibly eaten, that he could no longer doubt of it. They are incloſed in a grayiſh ſhell of the bigneſs of a barley corn, ſharper at one end than the other; by a good microſcope, he obſerved the ſhell covered all over with little ſtones, and ſmall greeniſh eggs, and at the ſharpeſt end, a little hole, by which they diſcharge their excrements; at the other extremity, a ſomewhat bigger hole, through which, they put out their heads, and faſten themſelves to the ſtones, they gnaw: They are not ſo confined in this ſhell, but that ſometimes they venture abroad; they are all black, about two lines of an inch long, and three quarters of a line broad; their body is diſtinguiſhed into ſeveral pleats or folds, and near their head, they have three feet on each ſide, with two joints, reſembling thoſe of a louſe: When they move, their body is commonly upright, with their mouth againſt the ſtone; the head is big, ſomewhat flat and even, of the colour of tortoiſe-ſhell, with ſome ſmall white hairs; they have alſo a big mouth, furniſhed with four kinds of jaw-bones, lying croſs-wiſe, which they move continually, opening and ſhutting them, like a pair of compaſſes with four branches: The jaws, on each ſide of the mouth, are all black, the nether jaw has a point, like the ſting of a bee, but uniform: They draw threads out of their mouth, with their fore-feet, making uſe of that point to range them, and form their ſhells of them: They have in all ten eyes, very black and round, appearing bigger than a pin's head, five on each ſide of the head.

Beſides theſe, he obſerved other ſmall worms, of the bigneſs of cheeſe-mites, that eat mortar, with two eyes only, and they are blackiſh: They have four feet, on each ſide, pretty long; the point of their muzzle is ſharp, as that of a ſpider. You may obſerve them more numerous in walls expoſed to the ſouth, than in others; ſuch as eat ſtone live longer than thoſe that feed on mortar, which ſcarcely ſurvive eight days. Without a good microſcope, and a great deal of attention, it is very difficult to obſerve them well.

The ſame gentleman found other very odd walls altogether eaten, as thoſe of the temple at *Paris*, where yet no worms were to be ſeen; only the cavities were full of ſhells of various kinds, and figures; all which he took for little petrified animals.

Petrification, *by Mr*. Ph. Packer. Phil. Tranſ. N° 19. p. 329.

NEAR *Wadley*, a mile from *Farrington* in *Berks*, grows an elm, which, having loſt the top, is now become hollow, containing near a tun of timber; from whoſe *but*, one of the ſpreading *claws* being formerly cut off with an ax; and that part of the *but*, whence it was ſevered, being about 1 ½ foot above ground; a petrified cruſt is formed, about the thickneſs of a ſhilling, all over the woody part within the bark; the marks of the ax are plainly to be ſeen in this petrified cruſt: How this ſhould happen, is not eaſy to explain, ſeeing there is no petrifying water near it, and that the part is above ground, and the tree ſtill growing; unleſs, being cut at a ſeaſon, when the ſap was flowing, the ouzing of it might be petrified by the air, and the tree grow rotten and hollow ſince that time.

Some Queries relating to Poland, *and other Northern Parts; anſwered by M.* Joh. Schefferus. Phil. Tranſ. N° 19. p. 350.

M. *Schefferus* conceives amber to be a kind of foſſil pitch, whoſe veins lie at the bottom of the ſea; which in time becomes hard, and by the waves is thrown a-ſhore: It was hitherto thought, to be found in *Pruſſia* only; but he aſſures, that it is alſo found in *Sweden*, on the ſhore of the iſle *Biorkoo*, and in the lake *Melero*, whoſe water is ſweet: To this M. *Hevelius* adds, that it is alſo dug up in ſubterraneous places, ſome *German* miles diſtant from the ſea.

That ſwallows plunge themſelves towards autumn into lakes, juſt like frogs; and that they have been ſeen to be drawn out together with fiſh in a net; and being brought to the fire, have thereby revived.

That many animals grow white in winter, and recover their own colour in ſummer; that himſelf had ſeen hares, which about the beginning of winter and ſpring were half white and half of their native colour; that in the midſt of winter, he obſerved them always white; that foxes are white in winter, and ſquirrels greyiſh.

That fiſh are killed by being confined under ice, eſpecially in ponds and narrow lakes, and where it is pretty thick, for where it

it is thin, they die not ſo eaſily: Such fiſh as lie in ſlimy or clayey ground, die not ſo ſoon as others; he adds, that fiſh are ſeldom found dead in great lakes, becauſe the ice is wont to be broken, either by the force of the waves, or of the impriſoned vapours.

That neither oil, nor a ſtrong brine of bay-ſalt is congealed into ice.

That the froſt penetrates into the earth, two cubits or *Swediſh* ells; that ſtanding waters freeze to three ells or more; but running water, not ſo much; that neither rapid rivers, nor ſprings freeze at all; theſe latter ſeeming to be warmer in winter than in ſummer.

A Method of transfuſing Blood *out of one Animal into another by Dr.* Lower. Phil. Tranſ. N° 20. p. 353.

THE method of transfuſion was firſt practiſed by Dr. *Lower*, and by him communicated to the honourable Mr. *Boyle*, who imparted it to the Royal Society, as follows:

Firſt, take up the carotid artery of a dog or other animal, whoſe blood is to be transfuſed into another, and ſeparate it from the nerve of the eighth pair, and lay it bare above an inch; then make a ſtrong ligature on the upper part of the artery, not to be untied again: But an inch below, *viz* towards the heart, make another ligature of a running knot, to be looſened or ſtraitened as there is occaſion; draw two threads under the artery between the two ligatures, and then open the artery and put in a quill and tie the artery very faſt upon the quill by the two threads and ſtop the quill with a plug. Afterwards, make bare the jugular vein in the other dog about an inch and a half long; and at each end make a ligature with a running knot, and between the two knots draw under the vein two threads; then make an inciſion in the vein, and put into it two quills, one into the deſcending part of the vein, to receive the blood from the other dog and convey it to the heart; and put the ſecond quill into the other part of the jugular vein (which comes from the head), out of which the ſecond dog's own blood muſt run into diſhes. Theſe two quills being put in and tied faſt, ſtop them with a valve, till there be occaſion to open them.

All things being thus prepared, faſten the dogs on their ſides ſo conveniently towards one another that the quills may go into each other. After that, unſtop the quill that goes down into the ſecond dog's jugular vein together with the quill in the firſt dog's artery, and inſert them into each other. Then ſlip the running

knots, and immediately the blood runs impetuoufly through the quills, as through an artery. As the blood runs into the dog, unftop the other quill coming out of the upper part of his jugular vein, firft making a ligature about his neck, or compreffing his other jugular vein with the finger, and let his own blood run out at the fame time into difhes, as you perceive him able to bear it, till the other dog begins to cry and faint and fall into convulfions, and at laft dye by his fide. Then take out both the quills out of the dogs jugular vein and tie the running knot faft and cut the vein afunder, one jugular vein being fufficient to convey all the blood from the head and upper parts, by reafon of a large anaftomofis, which is generally ufed for the opening of one veffel into another, whereby both the jugular veins meet about the larynx. This done, few up the skin and difmifs him; and the dog will leap from the table and fhake himfelf and run away, as if nothing ailed him.

In performing this experiment thefe circumftances are to be obferved. 1. That the animals be faftened at fuch a convenient diftance, as not to ftretch the vein or artery, elfe they will not convey fo much blood. 2. If the pulfe fail beyond the quill in the jugular vein, which muft be caufed by congealed blood, let the paffage be opened with a probe, that the blood may have its free courfe. For the dog that bleeds into the other, having loft much blood, his heart will beat faintly and the impulfe of the blood be weaker. But to prevent this inconvenience, you may bleed a great dog into a little one; or elfe provide feveral dogs, that when one begins to fall, another may fupply his place.

Inftead of a quill, a fmall crooked pipe of filver or brafs, fo flender that the one end may enter into a quill, with a fmall knob at the other end that is to enter into the vein or artery, for the better faftening them to it with a thread, for this is more manageable than a quill.

In thefe experiments of transfufion, it may be confidered that the blood of the emittent animal, may after a few minutes, run out with that of the recipient. In order, therefore, to be affured that all the blood of the recipient is run out, and none left but the adventitious blood of the emittent; three or more Dogs may be prepared as before, and when one begins to leave off bleeding, proceed to the fecond, and again to the third, and you will find the blood of the three animals will be receiv'd into that one dog that is defigned to live.

It feems reafonable to think that the exchange of blood will not alter the nature and difpofition of the animal; though it were

were to be wifhed that that point were determined by experiments. This cafe does not feem to be analogous to that of grafting, where the cyons turn the fap of the ftock into its own nature; the fibres of the cyons ftraining in fuch a manner the juice that comes from the ftem, as thereby to change it into that of the cyons; whereas in this transfufion, there feems to be no fuch percolation of the blood of animals, whereby that of the one, fhould be changed into the nature of the other.

The moft probable ufe of thefe experiments, may be that one animal may live with the blood of another; and confequently, that fuch as want blood, or have bad blood, may be fupplied with a fufficient quantity, and what is good; provided the transfufion be often repeated, by reafon of the quick expence that is made of blood.

Heads of inquiry for Turkey, Phil. Tranf. N° 20. p. 360.

1. IN what part of *Turky* the rufma, (a kind of earth ufed there for taking away hair) is to be found? Whether the *Turks* put it to any other ufe befides that of taking away hair? What are its kinds? How it is ufed in taking away hair, and how to get ftore of it?

2. Whether the *Turks* do not only take opium themfelves for infpiring ftrength and courage, but give it alfo to their horfes, camels and dromedaries when faint and tired in their travelling? What the greateft dofe of it is, and how prepared?

3. What are the effects not only of opium, but likewife of coffee, bathing, fhaving their heads, ufing rice, and why they prefer that which grows without watering, before wheat? &c.

4. How their *Damafco* fteel is made and tempered?

5. What is their way of dreffing leather, which though thin and fupple will hold out water?

6. What method they obferve in breeding thofe excellent horfes, that are fo highly efteemed?

7. Whether they be fo fkilful in poifoning, as is faid, and how their poifons are curable?

8. How the *Armenians* keep meat frefh and fweet fo long.

9. What arts or trades they have worth learning?

10. Whether there be fuch a tree about *Damafcus*, called mouflac, which yearly in *December* is cut down clofe by the root, and in four or five months time fhoots up again apace, bearing leaves, flowers and fruit, which is only one apple at a time?

11. Whe-

11. Whether about *Reame* in the ſouthern part of *Arabia Felix*, there be grapes without any grains; and whether many of the inhabitants live to 123 years in good health?

12. Whether there be any poiſonous creatures in *Candia*; and whether the ſerpents there be without poiſon?

13. Whether all fruits, herbs, earth, and fountains in the iſland of *Cyprus* are naturally ſaltiſh; and thoſe parts abounding with *Cyprus* trees, are more or leſs healthful.

14. The quantity of amianthus in *Cyprus*, and how 'tis wrought.

15. Whether mummies be found in the ſands of *Arabia*, which are the fleſh of men buried in thoſe ſandy deſarts in travelling; and how they differ in their virtue from the embalmed ones?

16. Whether the parts about *Conſtantinople* and *Aſia* be as ſubject to earthquakes now as formerly; and whether the eaſt winds infeſt that city with miſts, and cauſe that inconſtancy of weather it is ſubject to.

17. Whether the earthquakes in *Zant* and *Cephalonia*, be ſo frequent as to happen 9 or 10 times a month; and whether theſe iſlands be not very cavernous?

18. What is the height of mount *Caucaſus*, its poſition? &c.

19. With what declivity the water runs out of the *Euxine* ſea into the *Propontis*, and what depth, and if the many tides and eddies called *Euripi* have any certain period?

20. Whether the *Caſpian* empty itſelf into the *Euxine* ſea by any paſſage under ground?

21. What are the inland paſſages to *China*?

22. Whether the inſide of their aquæducts be lined with as good plaiſter as that of the ancients, and how made?

23. To make inquiry into the monuments of antiquity with which that country abounds, and particularly the bigneſs and ſtructure of the aquæducts made about *Conſtantinople*, by *Solyman* the magnificent? &c.

Optick Glaſſes *made of Rock-Cryſtal, by* Euſtachio Divini. Phil. Tranſ. N° 20. p. 362.

THOUGH it be commonly thought, that rock-cryſtal is not fit for optic glaſſes, becauſe there are many veins in it; yet *E. Divini* made one, that proved very good, though full of veins.

M. Verney's

M. Verney's *Account of the Use of the Grain of* Kermes *in Dying.* Phil. Tranſ. N° 20. p. 363.

THE Grain of kermes is an excreſcence growing on wood, and often on the leaves of a ſhrub common in *Languedoc*, and gathered in the end of *May* and beginning of *June*, and full of a red juice; 'tis uſed in medicine and dying. For the latter uſe, they take the grains of kermes, when ripe, and ſpread 'em on linnen, and turn 'em twice or thrice a day to prevent their heating. And when there appears a red powder amongſt 'em, they are paſſed thro' a ſearce, and this to be repeated till they yield no more powder. At firſt, when the ſmall red grains are ſeen to come, they are ſprinkled with ſtrong vinegar and rubbed between ones hands, and then formed into little balls expoſed to the ſun to dry. If this red powder ſhould be let alone without pouring vinegar, or ſome other acid upon it, every grain would yield a little fly; which flying about for a day or two, and at laſt changing its colour, would fall down dead, deprived of the bitterneſs, the grains, whence they are generated, are endued with. The grain being cleared of its pulp or red powder, is waſhed in wine and then expoſed to the ſun; when well dried, it is rubbed in a ſack to brighten it, and then put up in ſmall ſacks, putting in the middle 10, or 12 pounds of the duſt or red powder for a quintal. And accordingly as the grain affords more or leſs of that powder, it enhances or leſſens the price to the purchaſer. 'Tis to be noted, that the firſt red powder which appears, iſſues out of the hole of the grain on the ſide, where the grain adhered to the plant, and that which is about the end appears ſticking on the grain, has been alive in the huſk, having pierced its cover; tho' the hole, whence it commonly iſſues, remain cloſe ſhut to all appearance.

A Method to meaſure the Diameters of the Planets, *and the Parallax of the* Moon, *by M.* Auzout. Phil. Tranſ. N° 21. p. 373.

M. *Auzout* and *Picard* applied themſelves to take the diameters of the ſun, moon, and other planets, in a manner they thought preferable to any yet known, and which they could do to ſecond minutes, being able to divide a foot into 34000 or 30000 parts, to ſuch a degree of exactneſs, as not to come ſhort of the truth by 3 or 4 ſeconds. M. *Azout* found the diameter of the ſun in his apogæum, or greateſt diſtance from the earth, to be about 31 m. 37 or 40 ſec. and not leſs than 31 m. 35 ſec. and that at preſent, *viz. Dec.* 28, 1666, in his perigæum, or leſſer diſtance from

from the earth, it exceeds not 32 m. 45 ſec. and may be leſs by a ſecond or two. What occaſions the greateſt difficulty at preſent, is, that the vertical diameter, which is the eaſieſt to be taken, is diminiſhed even at noon, by 8 or 9 ſec. on account of the refractions, which are greater in winter than ſummer, at the ſame height; and that the horizontal diameter cannot be eaſily taken, becauſe of the ſwift motion of the heavens.

As for the moon, he never yet found her diameter leſs than 29 m. 44 or 45 ſec. and he did not obſerve it to exceed 33 m. and if it did, it was only by a few ſeconds, but he had not then obſerved her in all her ſituations of apogæum and perigæum, conjunctions and quadratures; he adds a method of finding the moon's parallax by her diameter, *viz.* if, when in her apogæum or perigæum, and in the moſt northerly ſigns, her diameter be taken towards the horizon, and then towards the ſouth, with her altitudes above the horizon; (for if the obſervation of the diameters be exact, as in theſe ſituations the moon changes not conſiderably her diſtance from the earth in ſix or ſeven hours,) the difference of the diameters will ſhew the proportion of her diſtance with reſpect to the earth's ſemidiameter. The ſame thing might be done with more advantage in thoſe places, where the moon paſſes through the zenith; for the greater the difference of the heights, the greater is that of the diameters; and if in two diſtant places under the ſame meridian, or in the ſame azimuths, the moon's diameter were taken at the ſame time, the reſult would be the ſame with the former, though not ſo exact.

From what has been ſaid, we may account for M. *Hevelius*'s obſervation in the eclipſe of *July* 2d, 1666, N. S. about the increaſe of the moon's diameter towards the end of it; for in eclipſes of the ſun, the moon's diameter muſt change, according to the hour and altitude of the moon; and had this eclipſe happened in the evening, the contrary to this would have been the caſe; for the moon, in that eclipſe, which began in the morning, being higher about the end, than at the beginning, was nearer us, and conſequently muſt appear bigger; but if the eclipſe had happened in the evening, ſhe would be lower at the end, and therefore at a greater diſtance from us, and conſequently appear leſs; and if this eclipſe had been obſerved in two different places, ſuppoſe at one place in the morning, and in the other at noon, the moon would appear bigger to him that obſerv'd the eclipſe at noon; and ſhe muſt likewiſe appear bigger to thoſe who have a leſs elevation of the pole under the ſame meridian, becauſe the moon will be ſo much nearer them.

Sir

Sir Gilbert Talbot's *Account of a* Swediſh Stone *which yields Sulphur, Vitriol, Allum, and Minium.* Phil. Tranſ. N° 21. p. 375.

THERE is a ſtone in *Sweden* of a yellow colour, intermixt with ſtreaks of white, as if compoſed of gold and ſilver, and heavy withal. It is found in firm rocks, and runs in veins, on which they lay wood, and ſet it on fire. When the ſtone is heated, they caſt water upon it, to make it rend, and then dig it up with mattocks. Afterwards 'tis broken into ſmaller pieces, and put into iron pots of the ſhape of figure 1. Plate III. the mouth of one going into the other. One of theſe is placed ſloping in the oven on an iron fork, ſo that the melted ſtone may run into the other ſtanding at the mouth of the oven, and ſupported on an iron; the firſt running of the ſtone is ſulphur. What remains of the burned ſtone is carried out, and laid on a high hill expoſed to the ſun and air for two years; then it takes fire of itſelf, yielding a thin blue flame, ſcarce diſcernable in the day time, and leaving a blue duſt behind it, which the workmen obſerve, and mark with wooden pins. This they dig up, and carry into the work-houſe, putting it into great tubs of water to infuſe for about 24 hours. The water is afterwards boiled in kettles, as we do ſaltpetre, and put into cooling tubs, wherein croſs ſticks are placed, on which the vitriol faſtens like ſugar-candy. The water that remains after the extraction of the vitriol, is mixt with an eighth part of urine and the lees of wood aſhes, which is again boiled very ſtrong, and being ſet to cool in tubs beſet with croſs ſticks, and on them the alum faſtens. In the water which remains after the alum, is found a ſediment, which being ſeparated from the water is put into an oven, and wood laid upon it and fired, till it become red, which makes the minium, wherewith they paint their houſes and make plaiſter.

There is a kind of ſtone in the north of *England*, yielding the ſame ſubſtances, except minium.

A Shower of Aſhes *in the* Archipelago, *by Capt.* W. Badily. Phil. Tranſ. N° 21. p. 377.

DECEMBER 6th, 1631, riding at anchor in the gulph of *Volo*; about 10 o'clock that night, it began to rain ſand or aſhes, and continued till 2 o'clock next morning: It was about two inches thick on deck, ſo that we threw it over board with ſhovels, as we did ſnow the day before: We brought home the quantity of a buſhel of it, and preſented it to ſeveral friends, eſpe-

ſpecially to the maſters of *Trinity* houſe. When the aſhes fell there was no wind ſtirring; they did not only fall where we were, but likewiſe in other parts, as ſhips were coming from St. *John d'Acre* to our port, though at that time 100 leagues from us. We compared the aſhes together, and found them both alike.

Of the Salamanders *living in Fire, by* N. Steno. Phil. Tranſ. N° 21. p. 377.

MR. *Steno* ſays, he was aſſured by a gentleman called *Corvini*, that upon caſting into the fire a ſalamander brought from the *Indies*, the animal preſently ſwelled, and vomited a quantity of thick ſlimy matter, which put out the adjacent coals, and thus ſaved himſelf from the force of the fire for two hours, after which it lived nine months: That he had kept it eleven months without any other food, beſides what it took by licking the earth on which it moved, and on which it had been brought out of the *Indies*; which at firſt was covered with a thick moiſture, that was afterwards dried up, but moiſtened by the animal's urine. After eleven months, the owner had a mind to try how it would do on *Italian* earth, but it died in three days after.

A Method of obſerving the Lunar Eclipſes, *by Mr.* Rook. Phil. Tranſ. N° 22. p. 388.

ECLIPSES of the moon are obſerved for two principal ends; one aſtronomical, that by comparing obſervations with calculations, the theory of the moon's motion may be compleated, and its tables reformed: The other geographical, that by comparing the obſervations of the ſame ecliptic phaſes made in divers places, the difference of meridians or longitudes of thoſe places may be diſcovered.

The knowledge of the eclipſes and duration, the ſhadows, curvity and inclination, *&c.* conduce only to the former of theſe ends. The exact time of the beginning, middle, and end of eclipſes, as alſo partial ones; and the beginning and end of total darkneſs, is uſeful for both.

But becauſe in obſervations made by the bare eye, theſe times conſiderably differ from thoſe with a teleſcope; and becauſe the beginning of eclipſes and the end of total darkneſs are ſcarce to be obſerved exactly, even with glaſſes (none being able clearly to diſtinguiſh between the true ſhadow and penumbra, unleſs he has ſeen, for ſome time before, the line, ſeparating them, paſs along on the ſurface of the moon) and laſtly, becauſe in ſmall partial eclipſes, the beginning and end; and in total ones of ſhort conti-

continuance in the ſhadow, the beginning and end of total darkneſs are unfit for nice obſervations, by reaſon of the ſlow change of appearances, occaſioned by the oblique motion of the ſhadow. For theſe reaſons I ſhall propoſe a method in obſerving lunar eclipſes, peculiarly adapted to that geographical end.

Firſt, it ſhall not be practicable without a teleſcope. Secondly, the obſerver ſhall always have opportunity before his principal obſervation, to note the diſtinction between the true ſhadow and penumbra. And, thirdly, it ſhall be applicable to thoſe periods of the eclipſe, wherein the alteration of the appearances are moſt ſudden. For which purpoſe, let a ſelect number of the moſt eminent ſpots, diſperſed over the moon's ſurface, be pitched on to be uſed in all parts of the world, as the following called by *Hevelius*, *Mons Senai*, *Ætna*, *Porphyrites*, *Serorum*, *Inſ. Besbicus*, *Inſ. Creta*, *Palus Mæotis*, *Maræotis*, and *Lacus Niger Major*.

In every eclipſe let, for inſtance, three of their ſpots, which then lie neareſt the ecliptic, be exactly obſerved when they are firſt touched by the true ſhadow; and again, when they are completely entred into it; and alſo in the decreaſe of the eclipſe, when they are firſt fully clear from the true ſhadow: For the accurate determinations of which moments of time, let the altitude of remarkable fixt ſtars be taken, of this ſide of the line, ſuch as lie between the equator and tropic of cancer; but beyond the line, ſuch as are ſituated towards the other tropic; and in all places, ſuch as at the time of obſervation are about four hours diſtant from the meridian.

A Halo *at* Madrid; *by the Earl of* Sandwich. Phil. Tranſ. N° 22. p. 390.

DECEMBER 25th, 1666, in the evening, there was a great Halo about the moon, whoſe ſemidiameter was about 23 deg. 30 m. *Aldebaran* was exactly in the north-eaſt part of the circle, and the two horns of *Aries* were ſurrounded by it on the ſouth-weſt, and the moon was in its centre. About five or ſix years before, *viz. November* 21ſt, 1661, an hour after ſun-ſet, the ſame nobleman obſerved at *Tangier*, a great halo about the moon, of the ſame diameter with the former, and the moon was very near the ſame place where ſhe was firſt obſerv'd.

Toads *and* Spiders *innoxious, and the latter tinge Water of a Sky Colour*; *by Dr.* N. Fairfax. Phil. Tranſ. N° 22. p. 391.

S. *Redi*, in N° 9. p. 161 of theſe tranſactions, had affirmed, that animals reputed venomous, were indeed no poiſons when ſwallowed, though they become ſuch when immediately

infecting the maſs of blood; Dr. *Fairfax* confirms the ſame thing, by inſtances and experiments he himſelf had ſeen, of ſpiders ſwallowed, and thoſe of the rankeſt kind, without any harm; and he alſo mentions ſome men that even eat toads, without receiving any hurt.

The ſame gentleman alſo relates, that on bruiſing a ſpider in a ſmall glaſs of water, it tinged it ſomewhat of a ſky colour; and that he was told, if a dozen of them were put in, they dye it almoſt a full azure. And it ſeems not more incredible, that this animal ſhould yield a ſky-colour when put in water, than that cochineel, which is but an inſect, ſhould give a fine red when ſteeped in the ſame liquor.

Obſervations on Ants; *by Dr.* Edmund King. Phil. Tranſ. N° 23. p. 425.

DR. *King* obſerved three ſorts of ants, commonly without wings, *viz.* very black; dark-brown; and a third ſpecies, reſembling the colour uſually called *feuille-morte*: Each ſpecies dwell a-part in ſeparate banks, two ſorts being ſeldom or never found together, there being a kind of enmity between them. Upon opening theſe banks, there is obſervable a white ſubſtance, like grains of fine white ſugar, or ſalt, but very ſoft and tender; and if you lay a bit of it on the object-plate of a good microſcope, and open it with the point of a needle, you may diſcern many pure, white, and clear appearances in diſtinct membranes, reſembling the eggs of the leſſer ſort of birds, and as clear as a fiſh's bladder; this very ſubſtance he found in the bodies of the ants themſelves, and he takes it to be the true ant's eggs: They are obſerved to lie in numbers upon it; and in a little time every one of them becomes a little worm, without any diſcernible motion; but in a few days more, they diſcover a feeble motion of flexion and extenſion, and then they begin to look yellowiſh, and hairy, in ſhape reſembling a ſmall maggot; and ſo retaining that ſhape, grow almoſt as big as an ant, with every one a black ſpot on them: Then they get a whitiſh and oval film all over them; for which reaſon, I ſuppoſe, they are commonly called ants eggs, tho' they are not properly ſo: Some of them he opened, and found a maggot only; in others, a maggot beginning to put on the ſhape of an ant about the head, with two little yellowiſh ſpecks, in the place of the eyes; in others, he found a further progreſs, as being furniſhed with every thing to complete the ſhape of an ant, but wholly tranſparent, except the eyes, which are then as black as black bugles: But when they newly put on this ſhape, he could never

never diſcern the leaſt motion in any one part of the little animals, which may be owing to the weakneſs of their fibres; for afterwards when they turn browniſh, they have ſtrength to ſtir all their members: Upon carefully opening ſome of theſe reputed eggs, he took out of ſeveral of them perfect and complete ants, which immediately crept about, only differing from other ants, in the feeble motion of their limbs: And this is a proof, that the film only covers the maggot while ſhe is transforming into an ant, and till ſhe is fit to ſhift for herſelf: The black ſpeck he ſuppoſes to be emitted out of the body of the maggot in its transformation, ſince, after it becomes an ant, the ſpeck diſappears.

It is obſervable, how upon breaking up their banks, their principal care is to ſecure their young, carrying them out of ſight, and laying the ſeveral ſorts of them in ſeveral places and heaps; and they know their young ſo well, that it is not poſſible to deceive them, by ſcattering among them fine ſugar, ſalt, or crums of wheat bread.

In a ſummer's morning they bring up thoſe of their young (that are vulgarly called ants eggs) to the top of the bank, for the moſt part on the ſouth ſide thereof, until five or ſix in the afternoon. But towards ſeven or eight at night, if it be cool or likely to rain, you may dig a foot deep before you can find them.

Ants are the principal food of young pheaſants and partridges, both wild and tame, for ſeveral weeks; and the chief reaſon, why many find it ſo difficult to rear up theſe birds, is, that either they give them too ſparingly of this food, or ſuffer them to faſt too long, not conſidering, that as ſoon as it is day-light, they will look out for it, and if they want it, will, in a few hours, become faint and weak: Yet when theſe birds are not kept ſweet, and their water is not often ſhifted, or their food is bad, as muſty corn, &c. and thus grow ſick, ants will not always recover them; but you muſt have recourſe to millepedes and earwigs, either of which do well, but both together better; given in a large quantity, twice or thrice a day, obſerving alſo to keep their houſe clean, and give them ſweet corn, and ſhift their water twice a day, and not let them out, till the dew is off the ground; let them baſk in ſand, partly in the ſun, partly a little ſhaded, and put them up in a warm houſe before ſun-ſet.

The Directions for Seamen *explained*. Phil. Tranſ. N° 24. p. 435.

TO find the variation of the needle. At land, where, by the help of good fixt dials and other proper inſtruments, the preciſe meridian of a place may be known, it is eaſy to find the needle's

needle's variation, and that different ways; as by applying the needle, &c. to the ſhadow of a thread hanging perpendicularly, when the ſun is in the meridian, or, to the meridian line; the ſide of a fixt horizontal dial, &c. But at ſea, as the meridian cannot be eaſily found to a tolerable exactneſs, the finding the variation is more laborious and difficult. The height of the pole and ſun's declination being known, a large ring dial, with a compaſs or needle fixt to its meridian below, may go near to ſhew the variation; for, when it is ſet to the preciſe hour and minute of the day, its meridian ſtands true, and ſo ſhews how far the needle varies from it: But as ſuch dials are rarely juſt, they are not much to be depended on: Inſtead of which, the following method may be uſed, *viz.* Find the ſun's azimuth diſtance from the meridian ſome hours before or after noon, *i. e.* by how many degrees, &c. of the horizon the ſun is diſtant from it; then find the ſun's magnetical azimuth, or its diſtance from the meridian ſhown by the needle, and the difference of theſe two is the needle's variation: In order to find the ſun's true azimuth, its declination, altitude, and the elevation of the pole muſt be known; to do which accurately, conſtitute a ſpherical oblique triangle of the three complements, of the ſun's declination, altitude, and height of the pole, and then finding the angle at the zenith, ſubtract it from 180, and the remainder is the ſun's true azimuth; which being found, as alſo the magnetical azimuth, ſubtract the leſſer from the greater, and the difference is the variation: If the magnetical azimuth be leſs than the other, then the variation is on the ſame ſide with the ſun, if greater, on the other ſide; to find this variation by the ſtars, no more is requiſite, than to find out the true north, or meridian, and compare the needle's poſition with it: It may be proper to uſe both ſun and ſtars in this problem, to attain to the greater certainty.

The dipping-needle is to be employed as often as the former problem is to be ſolved: As to the manner, all that is neceſſary, is to hang the circle, in which it moves, perpendicularly, and to turn it, till it is juſt in the magnetical meridian, where it dippeth moſt, and the degree of its depreſſion under the horizon is to be ſet down in a table. See Plate III. Fig. 2.

To ſound the depth of the ſea without a line: Take a globe of fir or maple, or other light wood (ſee Fig. 3.) as A; let it be well ſecured, by varniſh, pitch, or otherwiſe, from imbibing water; then take a piece of lead, or ſtone D, conſiderably heavier than will ſink the globe; let there be a long wire ſtaple B, in the ball A, and a ſpringing wire C, with a bended end F, and into the

the ſaid ſtaple, preſs in with your fingers the ſpringing wire on the bended end; and on it hang the weight D, by its hook E, and ſo let globe and all ſink gently into the water, in the poſture repreſented by the figure, the weight D touching firſt the bottom, is thereby ſtopt; but the ball, by the impetus acquired in deſcending, being carried downwards a little, after the weight is ſtopt, ſuffers the ſpringing wire to fly back, and thereby ſets itſelf at liberty to re-aſcend: And, by obſerving the time of the balls ſtay under water, by a watch, good minute glaſs, or beſt of all by a pendulum vibrating ſeconds, and with the help of ſome tables, any depth of the ſea may be known: In ſome of the trials that were made with this inſtrument, the globe being of maple wood, well pitched to prevent its ſoaking, was 5 $\frac{1}{16}$ inches in diameter, and weighed 2 $\frac{1}{4}$ pounds; the lead of 4 $\frac{1}{2}$ pounds weight, was of a conical figure, (but now it is uſed of a globular form), 11 inches long, with the ſharper end downwards, 1 $\frac{9}{16}$ in diameter at bottom: And in thoſe experiments made in the *Thames*, in 19 foot water, there paſſed between the immerſion and emerſion of the globe, 6 ſeconds; and in 10 foot water, about 3 $\frac{1}{2}$ ſeconds; and from ſuch experiments, it will be eaſy to find out a method to calculate any depth from any time of the globe's ſtay under water; for inſtance, if in 20 fathoms, meaſured by the line, the globe continue under water 15 ſeconds; then if it ſtay 700 ſeconds the depth will be 933 fathoms and 2 feet, if the ball be ſuppoſed to move equal ſpaces in equal times: In the abovementioned experiments in the *Thames*, it was found, that there was no difference in time between the ſubmerſions of the ball at the greateſt depth, when it roſe ſeveral yards from the place where it was let fall, being carried by the current of the tide, and when it roſe only at a yard's diſtance.

An experiment made with a lead, whoſe iron hook was faſtened a-top, ſee fig. 4. ſucceeded very well, and the ball returned in 34″ $\frac{1}{2}$; but on account of the current, it could not be perceived, when the lead touched the bottom. This lead being let down without a line, the ball returned in 32″ $\frac{1}{2}$. Another trial was made with a line, and the point of the lead was bent, as in fig. 5. and the ball returned in 34″. The ſame let down without a line, the ball returned in 6 or 7 vibrations, which ſhowed it did not reach the bottom: In an experiment with a lead, whoſe nail was ſet a-wry, fig. 6. the ball returned in 34″, and the depth was afterwards found to be juſt 14 fathoms.

The

The ſtrength of the winds is meaſured by an inſtrument, repreſented by fig. 7. which being expoſed to the wind, with its flat ſide right againſt it, the number of degrees upon the limb A B, to which the wind raiſes the flat ſide C D, ſhews its force, in proportion to the reſiſtance of the flat ſide.

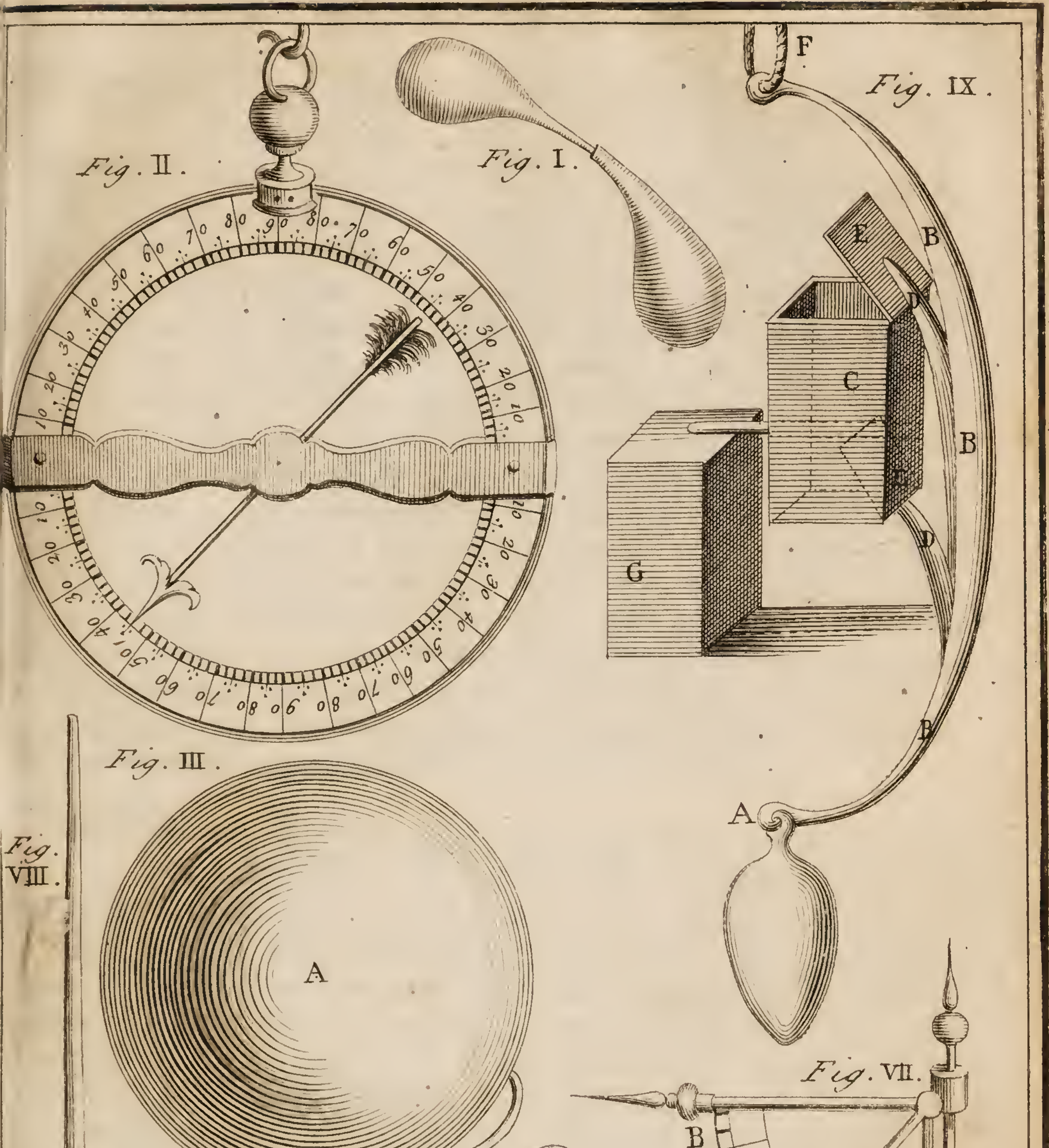
The glaſs-phials, for meaſuring the different gravities of ſalt water, is to be made with a very narrow neck, and when almoſt full, the water is to be put into it by drops, till it can hold no more, drying well the phial before it is weighed, after taking firſt the weight of the empty phial, and by evaporating gently the water, till nothing but ſalt remains at bottom, the proportion the ſalt of each water has to its weight may be known.

Mr. *Boyle* deſcribes a glaſs-tube, fig. 8. blown at a lamp, and poiſed in common water, by putting quickſilver into it, till it ſink ſo low, that nothing but the top, may appear above the water; after which it is to be ſealed up, and graduated on its ſide into what parts you pleaſe, which may be done with a diamond: And then, being put into the water that is to be weighed, it will, by its ſinking more or leſs, ſhew the difference of the water's gravity.

To fetch up water from any depth of the ſea: Let there be made a ſquare wooden bucket C, fig. 9. whoſe bottoms E E, are ſo contrived, that as the weight A ſinks the iron B, (to whieh the bucket C is faſtened by two handles D D, on the ends of which are the moveable bottoms or valves E E,) and thereby draws down the bucket; the reſiſtance of the water keeps up the bucket in the poſition C, whereby the water has, all the while the bucket is deſcending, a clear paſſage through; whereas, as ſoon as the bucket is pulled upwards by the cord F, the reſiſtance of the water to that motion beats the bucket downwards, and keeps it in the poſition G, whereby the included water is kept from getting out, and the ambient water from getting in.

By this veſſel the nature of ſea water at ſeveral depths may be known, and whether it be ſalter at top than bottom, and that in different climates whether ſweet water may be found in ſome places of the ſea, as *John Hugh van Linſchoten* affirms in his *Eaſt India* voyages, that in the *Perſian Gulf*, about the iſland *Barem* or *Baharem*, ſweet water is fetched up at the depth of four or five fathoms.

The



Hulett Sculp

Transfusion of the Blood of a Calf *into a* Sheep *by the Veins only.* Phil. Tranf. N° 25. p. 449.

THIS was firft practifed by Dr. *Edmund King*, and the fuccefs thereof in two experiments he communicated to the Royal Society, as follows: He took a calf and a fheep, both of the larger fort, and having prepared a jugular vein in each, he inferted his pipes and quills, as ufual, both in the jugular vein of the calf defigned to be the emittent, and in that of the fheep, intended for the recipient: Then he let out 49 ounces of blood, avoirdupoize weight, of the fheep, before it received any other blood; about which time concluding the fheep to be faint, and finding the blood run flowly, he ftopt the vein of the fheep and unftopt the pipe in the calf, letting 10 ounces run out into a porringer: Then he conveyed pipes from the emittent calf's vein into the recipient fheep's vein; and fuppofing that the fheep had received more blood than it had loft, he ftopt the current of blood from the calf and clofed alfo the fheep's vein; and untying her, fhe went about and appeared to have as much ftrength as fhe had before the lofs of her own blood.

Transfufing the Blood of a mangey Dog *into a found one, by Mr.* T. Coxe. Phil. Tranf. N° 25. p. 451.

MR. *Coxe* procured an old mungrel Cur, all over mangey, of a middle fize; and having, fome hours before fed him plentifully with cheefe parings and milk, he prepared his jugular vein; then he made a ftrong ligature on his neck, that the venal blood might be emitted with the greater impetus: After this, he took a young land-fpaniel, about the fame bignefs, and prepared his jugular vein likewife, that the defcendent part might receive the mangey dog's blood, and the afcendent difcharge his own into a difh; he transfufed about 14 or 16 ounces of the blood of the infected into the veins of the found dog; by this experiment there appeared no alteration in the found one, but the mangey dog was in about 10 days, or a fortnight's time, perfectly cured; and poffibly this is the quickeft and fureft remedy for that difeafe both in man or beaft.

The re-uniting the feparated Bark of a Tree, by Dr. Merret. Phil. Tranf. N° 25. p. 453.

IN the middle of *March* the Doctor made an incifion in the rinds of afh, and of the tree improperly called fycamore. The firft fection of each of the rinds was fquare, whereof three fides

were cut, and the fourth uncut. The ſucceſs was, that the whole bark did unite, by binding it with packthread, leaving a ſcar in each of the cut ſides: Then he cut off, and ſeparated entirely from the tree, ſeveral parts of the bark, ſome ſhallower, leaving part of the bark on, others to the very wood itſelf, and ſome of them he bound cloſe with packthread, all which were ſeparated and a new rind ſucceeded in their place. Some he covered over, beyond the place of inciſion, with a diachylon plaiſter, and faſtened them with packthread. All which, thus bound and plaiſtered, in three weeks time, were firmly united to the tree. But tying the ſame about *Michaelmas*, and in the winter ſeaſon, no union could be made of the bark; becauſe, as he ſuppoſes, the ſap mounted not ſo vigorouſly, nor in ſuch plenty, as in ſpring.

To recover Cherries *almoſt withered, by Dr.* Merret. Phil. Tranſ. N° 25. p. 455.

ANNO 1665, the doctor made the following experiment on three may-cherry-trees, planted in a rich mould, near a ſouth wall, and ſhaded from the ſun by a high building, till the beginning of *March*; and then being high, and ſhining ſtrongly upon them, the fruit conſtantly withered: But this year, the ſeaſon being very hot and dry, he bared the roots of one of them, by digging about it, and watered it morning and evening with about a gallon of water, for a fortnight, before the cherries came to redneſs; and the fruit became full and good; the other two trees, that were neglected, had moſt of their fruit withered. Now to proſecute this experiment further, he dug about one of the other trees, and watered it daily, like the former; in a week's time, the fruit, that was quite withered, fell off, and the reſt that was not ſo, throve exceedingly; the other tree, that was not uſed in this manner, had not any of its fruit come to perfection.

The American Aloe, *with indented Leaves; by the ſame.* Ibid.

ANNO 1656, this aloe weighed 21 ounces, 6 drams, 2 grains; its colour was a pale green, conſiſting of 11 leaves, it was bound about with a red dry cloth, and hung up, without oil, in the kitchin: In a whole year, it loſt 2 ounces, 3 drams, 24 grains; the ſucceeding year being drier and hotter, it loſt 3 ounces, 2 $\frac{1}{2}$ ſcruples; and more than double in the ſix colder, than the ſix hotter months: He kept it in about five years, and it decreaſed in about the ſame proportion: And in 1660, hanging it in a cold garret, it died: He obſerved that every year two of the greater leaves

leaves firſt changed colour, and withered; and every ſpring, there ſucceeded two freſh and green ones, of the bigneſs of the preceeding, ſo that he always had the ſame number of leaves: And they were freſher and greener, and not ſerrated, or indented, and thicker alſo, in proportion; from the growth of theſe leaves, it may be probably inferred, that there is a circulation of the *Succus nutritius*, or nutritious juice in this plant; for how is it poſſible, that the roots, continuing as firm and ſolid as at firſt, ſhould ſupply ſo much nouriſhment, as to produce new leaves, unleſs the ſaid nutritious juice returned from the old decayed leaves into the root, and ſo produced new ones?

An Account of Mr. Gaſcoigne's Micrometer; *by Mr.* R. Townley. Phil. Tranſ. N° 25. p. 457.

MR. *Townley* obſerving, in N° 21. p. 373 of the Tranſactions, a hint of a method of M. *Auzout*'s, of dividing a foot nearly into 30000 parts, and thereby taking angles to a great exactneſs, informs the world, that he had found by ſome ſcattered papers of one Mr. *Gaſcoigne*'s, that before the late civil wars, he had not only deviſed an inſtrument of as great a power as M. *Auzout*'s, but had alſo uſed it for ſome years, for taking not only diameters of the planets and diſtances on land, but alſo for finding the moon's diſtance, from two obſervations of her horizontal and meridional diameters; which Mr. *Townley* the rather mentions, becauſe the *French* aſtronomer eſteems himſelf the firſt, who thereby undertook to ſettle the moon's parallax. Mr. *Townley* adds, that the machine is ſmall, not exceeding in weight or bigneſs an ordinary pocket watch, and dividing a foot into 40000 parts, by the help of two indexes, the one, ſhewing hundreds of diviſions, the other, diviſions of the hundred; that every laſt diviſion, in his ſmall one, contained $\frac{1}{10}$ of an inch; and that he had taken land-angles ſeveral times to one diviſion, tho' it be very hard to come to that exactneſs in the heavens, becauſe of the ſwift motion of the planets; but in order to remedy this, he himſelf had deviſed a *reſt*, that was eaſily made, and very manageable; he further adds, that he was in poſſeſſion of the very firſt inſtrument Mr. *Gaſcoigne* made; beſides two others that were more perfect, and which he would have ſtill further improved, had he not been unfortunately ſlain in his majeſty's ſervice.

The Nebulosa *in the Girdle of* Andromeda; *and an extraordinary* Star *in the Neck of the Whale*; *by M.* Bullialdus, Phil. Transf. N° 25. p. 459.

JANUARY 1667, the *Nebulosa* in andromeda's girdle, which may be seen by the naked eye, appeared much more obscure than the year before.

January 20th, 1667, at night, 6 h. 30′, the sky being pretty clear, the star in the neck of the whale approached to the bigness of one of the sixth magnitude, and grew afterwards bigger. *February* 12th, 6 h. 30′, it was equal to a star of the fourth magnitude. *Feb.* 24th, 7 h. it appeared like one of the third magnitude, shining very bright. *Feb.* 26th and 27th, it appeared still to increase.

To this M. *Hevelius* adds, that he found, *Jan.* 23d, a little star of the sixth or seventh magnitude about the same place, where the said new star is wont to appear; but that then it seemed not to be the genuine new star, but another preceeding the new one, and whose longitude *Anno* 1660, he defined *Aries* 25°, 43′, 3″, and latitude, 14°, 41′, 32″, south. *Feb.* 2d, it appeared very bright, and when the moon shone, of the bigness of that in the whale's mouth or *Nodo Lini*, from which time, it was always observed to grow bigger. *March* 13th, he still found it exceeding bright, but could not accurately determine its magnitude by the naked eye, on account of the vivid twilight and the lowness of the star.

A Communication of the Ductus Thoracicus *with the emulgent Vein*; *by M.* Pecquet. Phil. Transf. N° 25. p. 461.

IN dissecting a woman who died a few days after being brought to bed, M. *Gayant* discovering the *Ductus Thoracicus* on the 7th and 8th vertebra's of the back, inserted a quill into the *Ductus*, and upon tying it on the quill, and blowing into it, the inflation reached the subclavian vein, and the wind escaped at the *Cava ascendans*, which had been cut in making the demonstration of the heart, but upon compressing both the *Vena cava* and *Ductus Thoracicus*, and on M. *Gayant*'s blowing a-fresh, the wind had another way to escape, and the left emulgent vein was found inflated; and from the emulgent, the *Cava* was filled to the *Iliacs*; this wind seemed to come from the left kidney, and to insinuate itself into the emulgent vein, and thence into the *Cava*: Upon slitting the *Cava* at the emulgent, and then blowing into the *Ductus Thoracicus*, he observed the wind, that swelled the emulgent, escape at the slit in the *Cava*: This experiment

riment made him judge, there was a communication of the *Ductus Thoracicus* with the left kidney, or at leaſt with the emulgent vein in the body of this woman: To make this clearer, the lungs of the left cavity of the thorax were removed, and M. *Gayant* did blow into the *Ductus Thoracicus*, whilſt the vein and *Ductus* were compreſſed on a third vertebra; and the wind was obſerved to inſinuate itſelf under the pleura about the fourth vertebra; which made him conclude there was a communication under the pleura from the *Ductus Thoracicus* to the emulgent vein; becauſe the wind got in, on the ſide of the kidney, into the emulgent vein, and come out at the hole of the *Cava*, that had been made in the firſt experiment: This channel of communication was perceived to come from the *Ductus Thoracicus* at the fourth vertebra of the back; and that he might be the ſurer of this, the *Ductus* was compreſſed on the fifth vertebra of the back, and blowing into the quill, which was upon the ſeventh, the wind paſſed neither to the kidney nor emulgent vein; whence it was concluded that the communication was not below the fifth vertebra: Then compreſſing the *Ductus* and *Vena cava* on the third vertebra, the emulgent ſwelled, upon blowing into the quill; which gave grounds to think, that the part of the *Ductus*, that communicated with the emulgent, was between the third and fifth vertebra of the back; and to be aſſured of this, the *Ductus* was ſlit upon the third vertebra, and blowing into it, the wind came out at the axillary vein, and aſcending *Cava*; but the emulgent ſwelled not at all: There was a fourth experiment, which ſeemed very curious, *viz.* upon blowing into the *Aorta*, all whoſe branches, that had been cut, were tied up, it ſwelled immediately, and the emulgent artery was inflated at the ſame time, without affecting in the leaſt the emulgent vein; which ſhews, that blood often paſſes where air does not; for the blood of the emulgent artery, returns through the emulgent vein into the *Cava*; there was another proof of this in the lungs of a woman, where the air that was propelled into the *Vena arterioſa* returned not through the *Arteria venoſa*, into the left ventricle of the heart.

A Deſcription of Granaries. Phil. Tranſ. N° 25. p. 464.

THE twelve companies of *London*, and ſome other companies and private perſons, have their granaries at the bridge-houſe in *Southwark*. They are built on two ſides of an oblong; one whereof ſtands north and ſouth, and near 100 yards long, whoſe lattice windows look north-eaſt; the other ſide may be about

about 50 yards long; the windows face to the north, and the opposite sides have no apertures. All the windows are about a yard high, without any shutters, and run on in a continued series, with very small partitions, sufficient only to nail the lattices to. Each of the granaries is three or four stories high; the garret windows are jetty-wise, at a yard's distance from each other, glazed out of the tiles. The ground or lowest story, 12 foot from the ground, is used only for a ware-house, *&c.* If the first story was built on strong pillars, fortified with spikes of iron, that no vermin might get up, it would make that story fitter for drying of corn: The other stories, made for granaries, are about six yards broad, and a little more than six foot high. The uppermost or garret granary to the top or angle, much more. In the middle of each, from the sides, at eight or nine foot distance, there is a strong post; and all the timbers are made very strong, to support the great weight of the grain. The boards are best made of sound oak, two inches thick, and close jointed. In some places they put iron-wire of so narrow meshes, in all the inside of their rooms, two or three foot deep, that neither rats nor mice can get through them. Others, for the same purpose, raise on all sides boards of timber, and fasten others to their top; for, besides the destroying the grain, the excrements and urine of those vermin, make them apt to corrupt and breed weevils.

What is mainly to be considered in building these granaries, is the making them strong, and exposing them to the most drying winds.

The ordering of the corn in *Kent*, is in this manner; after threshing, it is thrown in shovels from one side of the room to the other, and the greater the distance, at which it is shot, so much the better for separating the dust, and other impurities, which will fall in the middle between the two heaps of corn; after this they skreen it. When the grain is first brought into the granaries, it is laid about half a foot thick, and turned twice a week, and once in that time they skreen it; and this for two months: After that, it is laid a foot thick, for two months more, turning it once or twice a week; and they skreen it according to the drying season, seldomer or oftner; in five or six months it is raised to the height of two foot, and turned once a fortnight, and skreened once a month, as there is occasion. In a year, they lay it two and a half or three foot deep, and turn it once in three weeks, or a month, and skreen it proportionably. After lying two years, or more, they turn it once in two months, and skreen it once a quarter, according to its brightness, hardness, and dryness;

neſs: The oftner theſe two things are done, the better the grain proves. They leave an empty ſpace about a yard wide on all ſides of the room, to turn the corn into it, as often as it is needful: They likewiſe make two ſquare holes in both the ends of the floor, and a round one in the middle, by which the corn is conveyed from the upper into the lower rooms to air and dry it the better. The ſkreens are made with two partitions, to ſeparate the corn from the duſt; which falls into a bag, and when ſufficiently full, is thrown away, leaving the good corn behind. Corn has been kept for 32 years in the *London* granaries; and the longer it is kept, the more flour it yields, in proportion to the quantity of the corn; and it makes the purer and whiter bread, the ſuperfluous humidity only evaporating.

Dr. *Pell* obſerv'd at a meeting of the Royal Society, that they kept corn at *Zurich* in *Switzerland* 80 years.

The granaries of *Dantzick* are generally ſeven ſtories high, and ſome, nine; with each a funnel, for the corn to run down from one floor to another, thereby ſaving the labour and charges of carrying it down: All the granaries are ſurrounded with water, whereby ſhips may lie cloſe to them, and take in their lading: No houſes are ſuffered to be built near them, in order to prevent fire.

The granaries of *Muſcovy* are made under ground, by digging a deep pit, of almoſt the figure of a ſugar loaf, broad below, and narrow a-top; the ſides well plaiſtered round about, and the top cloſe covered with ſtone: They are ſo very careful to have the corn well dried, before they put it into thoſe ſubterraneous granaries, that when the weather does not ſerve to dry it, they heat their barns by the means of great ovens.

Experiments to determine the point-blank Diſtance, *the Charge of* Powder, *and beſt Size of* Guns; *by Sir* Rob. Moray. Phil. Tranſ. N° 26. p. 473.

I. TO know how far a gun ſhoots point-blank, that is, near the level of the cylinder of the piece.

On a fit platform, place and point the gun at a mark as large as the bullet, at the diſtance of 50 or 60 yards or more, that the under ſide of the mark may be in the ſame level with the under ſide of the cylinder of the piece: Then between the gun and the mark, at proper diſtances, faſten pieces of canvas, ſheets of paper paſted together, or the like, on ſtakes fixt in the ground; ſo that the under ſide, being level with the horizon, may juſt touch the viſual ray that comes from the eye to the upper ſide of the mark, when

when it is in the line drawn from it to the upper ſide of the cylinder of the gun; the canvas being ſo broad and long, that if the bullet paſs through it 2 or 3 foot higher than the level of the mark, or on either hand, the hole it makes may ſhew, how much it flies higher than the level of that place. If the bullet fall lower than the mark, and touch not the canvas, the gun may be raiſed a little, and ſo on, till the bullet hit the mark; if it fall as high as the mark, and cut the canvas, the mark and canvas may be brought nearer the gun; but if it fall as high as the mark, and cut not the canvas, the mark may be removed to greater and greater diſtances.

If this experiment be made for greater diſtances and elevations of the piece, and theſe diſtances meaſured, and then all randoms, or elevations above theſe likewiſe meaſured; the diſtance of an object, to be ſhot at, being known, good gunners may undertake to hit a mark, be the diſtance what it will, ſo it exceed not the reach of the gun.

II. What quantity of powder is the juſt charge of any piece, ſo as to ſhoot fartheſt, and all the powder take fire?

1. Elevate the gun to a mean random, as of 20° or 25° and ſhoot with the ordinary charge of powder, in ſome convenient place, where the fall of the bullet may be eaſily ſeen; and meaſure the diſtances with a chain between the hole made by the bullet and the muzzle of the gun. 2. Then inſtead of a full charge of powder, take $\frac{1}{16}$ part leſs, or ſome ſuch proportion, for the next trials. 3. For a third, fourth, or more trials, diminiſh ſtill the quantity of powder, by $\frac{1}{16}$ at a time, till the ſhot be conſiderably ſhorter than at firſt. 4. Then take $\frac{1}{16}$ more than the firſt charge, and do all things elſe as before, and ſo encreaſe ſtill the quantity of powder in the ſame proportion every new trial, till you find the increaſe of the charge does not make the piece ſhoot farther; only overcharge not, ſo far as to endanger the gun. 5. Three or more ſhots to be made with every different charge, and at each ſeveral trial. 6. The firſt ſhot being meaſured the reſt may all be meaſured from it. 7. The gun is to be pointed each time to the ſame mark, that the ſhot may all fall in the ſame line, as near as poſſible. 8. The powder, which ought to be all of the ſame goodneſs, muſt be exactly weighed each time the piece is charged. 9. The powder and ball is to be rammed home equally at each ſhot; tho' the looſer the powder lies, it fires the better. 10. When the true charge of a piece, that ſhoots fartheſt is found, M. *de Son*'s contrivance of a wedge may be tried, to make it ſhoot ſtill farther; which is a piece of board,

with

with one end, when thruſt home, reaching the breech of the piece, and the other ſtanding farther out than the outſide of the bullet when rammed to its place; and let it be about an inch broad, and thin, the length of the wadd before the bullet, where it is to have a ſhoulder, from which forward to the end, it is to be cut a-ſlope, like a wedge; of ſuch a thickneſs in the place where the centre of the bullet is to be, that making it ſtick the faſter, the powder may find the greater reſiſtance, and drive it out with the greater force. 11. For the ſame purpoſe, a wooden tampion may be uſed, in length ſomewhat more than the diameter of the gun, and hollow towards the bullet, ſo as to fit it; and either flat or rather hollow towards the powder, and ſerve inſtead of wadding: Theſe, and ſuch other contrivances, will probably render the effect of the powder greater, than otherwiſe it would be. 12. The ſtrength of the powder muſt be examined by a powder-trier, that raiſes a weight, ſuch as that contrived by Dr. *Hook*. 13. The ſame bullet, if it can be had, is to be uſed, till its figure be marred; elſe, another of the ſame ſize and weight, as near as poſſible. 14. Obſerve the ſtrength and poſition of the wind, and at what point the mark ſtands from the gun, at each diſcharge; as alſo, what effect the wind has on the bullet. 15. Obſerve the figure, dimenſions, and weight of the gun, carriage and wheels; and let the latter at every ſhot, be put in the very ſame poſition; the platform be very level; and let every thing be exactly recorded in a book. 16. After all other experiments are made, every piece may be tried with the right charge of powder, and at each time weights may be laid on the carriage, till it recoil not at all, obſerving how far the bullet goes, and how much leſs than the full charge will ſerve to ſhoot the bullet, when the piece is fixt, than when it recoils freely. 17. Upon finding the true charge, the beſt random is to be ſought for, by trying all randoms.

III. To know what gun ſhoots fartheſt.

1. A gun of culverin-bore, but much longer, double the ordinary length may do very well, is to be placed as in the preceeding experiments, and with the ordinary charge of a culverine; or rather that quantity, which by the former trials will be found the beſt; and after diſcharging, the fall of the bullet is to be marked, and the diſtance to be meaſured. 2. Then try leſs and greater quantities of powder. 3. Cut off two inches of the muzzle with a ſaw, and put theſe pieces, on the carriage, or their weight in lead, that the recoil may ſtill be the ſame; cutting off for new trials, till the ſhot begin to fall ſhorter than before. 4. The ſame

may be done with guns of different bores. 5. The long guns are to be made without any ring about the muzzle.

Magnetical Experiments; by Mr. Sellers. Phil. Tranf. N° 26. p. 478.

MR. *Sellers* made trial with feveral needles, touching them on each hemifphere of the load-ftone, in all the different ways he could devife; but they all ftood north and fouth, as other needles, that were touched on the very pole of the ftone; he found on frequent trials of touching needles on different load-ftones of feveral bigneffes, as alfo of different virtues, that the feveral needles touched on thefe different ftones, gave all of them the fame directions; which is alfo confirmed by all the needles and fea-compaffes, made in the feveral parts of the world, fince they all point north and fouth: He alfo obferved, that fometimes drawing a needle, only over the pole, within the fphere of its activity, without touching the ftone at all, it acquired the fame directive power, tho' not fo ftrong, as if it had touched the ftone; again, touching faintly fome needles, and others more ftrongly, they all had the fame power from the ftone, both in refpect of ftrength and direction; he obferved, that the nature of the fteel, ufed in the needles, together with its temper, has different effects on the ftrength of the virtue received from the ftone; fo that a piece of fteel fhall take up two ounces or more of Iron, and impart to a needle the magnetical direction, without the help of a load-ftone, or any thing elfe touched by it.

An Account of the Effects of transfufing Blood, *and of two monftrous* Births, &c. Phil. Tranf. N° 26. p. 479.

MR. *Gayant* transfufed the blood of a young dog, into the veins of an old one, who, two hours after, leapt and frifkt about; whereas, before, he was almoft blind with age and could hardly ftir.

In the houfe of M. *Bourdelot* was fhewn a monfter in form of an ape, having all over its fhoulders, almoft to its middle, a mafs of flefh, that came from the hinder part of its head, and hung down in form of a cloak: It was reported the mother had feen on the ftage, an ape fo cloathed; and what was remarkable, this mafs of flefh was divided into four parts, like the coat the ape wore: Upon inquiry, the woman was found to have gone five months with child, before this unlucky fight. Many queftions were handled on this occafion, *viz.* about the power of imagination, and whether this creature was endowed with a hu-

man ſoul; and if not, what became of the ſoul of the embryo, that was five months old. In ſome time after, another monſter was produced, which was an infant come to maturity, having, inſtead of a head and brains, a maſs of fleſh like a liver; which was found to move. This gave riſe to a queſtion againſt the *Carteſians*, *viz.* how that motion could be performed, and yet the *glandula pinealis* or *conarium* be wanting, and no viſible nerves from the brain? The marrow in the ſpine was of the ſame ſubſtance; it lived four days and then died.

M. *Steno* has alſo ſomewhat perplexed *des Cartes*'s followers, by an inſtance of a tortoiſe, whoſe head was cut off, and yet was found to move its feet three days after; here being no communication with the *Conarium*.

An Account of two monſtrous Births *in* Devonſhire, *by Mr.* Colepreſs. Phil. Tranſ. N° 26. p. 480.

FEB. 24th 1666-7. One *Robert Cloak* a joiner of *Clamick*, in the pariſh of *Beer-ferris* in *Devonſhire*, had a monſtrous black lamb fallen with one head, but two diſtinct bodies joined at the neck; and eight legs: It had two eyes, and as many ears in the uſual manner, and one extraordinary eye in the niddock, with one ſingle ear, about an inch from the eye backwards: Its dam was white, and uſually yeaned two lambs every year.

About the ſame time, *John Cauce*, of the ſame pariſh, had a white lamb fallen, with two diſtinct heads and necks, joined at the ſhoulders, and one body, well formed, yet with double intrails.

Some Obſervations both in Mines *and at* Sea, *by the ſame.* Phil. Tranſ. N° 26. p. 481.

MR. *Colepreſs* relates that diſcourſing with one *John Gill*, a man well experienced in mineral affairs, the ſaid *Gill* affirmed, that if, in digging deep under ground, the workmen meet with water, they never want air or wind; but if they miſs water, as ſometimes it happens, even at 12 or 16 fathoms, they are deſtitute of air, either to breathe in, or for their candles to burn; and again, when, on account of a great quantity of winter water ſtanding in a mine, an adit is driven up for draining it; as ſoon as the water begins to flow, the men muſt ſecure themſelves from being daſhed in pieces againſt the ſides of the adit: For the included air breaks forth with a noiſe, like that of a piece of ordnance, and with a violence that carries all before it, looſening the very rocks: He obſerved alſo on ſeveral occaſions in

in ſailing from *London* to *Plymouth*, that in a calm, which way ſoever the ſea began to loom or move, next day, the wind was ſure to blow from that point.

Hail Stones *of an unuſual Bigneſs*; *by Dr.* Nath. Fairfax. Phil. Tranſ. N° 26. p. 481.

JULY the 17, 1666, about 10 in the forenoon, there fell a violent ſtorm of hail on the coaſt towns of *Suffolk*: The hail was ſmall near *Yarmouth*, but at *Seckford Hall*, a hail-ſtone was found 9 inches about, at *Snape-Bridge*, 12 inches in circumference; and on putting one into a balance, it weighed 2 ½ ounces: Several people in *Aldborough* affirmed, ſome hail-ſtones to have been full as big as turkey-eggs; and a carter had his head broken thro' a ſtiff country felt; and his horſes were ſo pelted that they hurried away; the hail-ſtones ſeemed all white, ſmooth on the outſide, and ſhining within; it is ſomewhat ſtrange, that their column of air ſhould ſuſtain them, unleſs we ſuppoſe them to unite in the fall.

A Well *and* Earth *in* Lancaſhire *taking fire at a Candle*; *by* Th. Shirley, *Eſq*; Phil. Tranſ. N° 26. p. 482.

ABout a mile from *Wigan* in *Lancaſhire* is a ſpring, whoſe water is ſuppoſed to burn like oil; it is true, that on applying a candle to it, there is ſuddenly a large flame produced, and the water at the burning place is obſerved to boil, tho' on putting the hand into it there is no warmth felt: This boiling may be conceived, to proceed from the eruption of ſome bituminous or ſulphurous fumes; for on applying the hand to the ſurface of the burning place of the water, a ſtrong wind is felt, and this place not being above 30 or 40 yards from the mouth of a coal-pit, and indeed all the country for many miles being underlaid with coals, may ſerve to confirm this opinion; and from theſe fumes and not from the water itſelf the flame is produced; for on applying a lighted candle to divers parts of this water in a ditch, into which it run, no flame enſued; and again taking up a diſhful at the flaming place, and holding the candle to it, it went out. Upon making a dam and hindering the water's courſe to the burning place, and draining the water that was there already, and applying the burning candle to the ſurface of the dry earth, at the place where the water burned before, the fumes took fire and burned very bright and vigorous, but on throwing a bucket full of its own water on it, the fire was preſently quenched. The flame was not diſcoloured, like that of ſulphurous bodies, nor had it any ſcent; the fumes that broke out of the earth, and preſt againſt the hand, were not at all hot.

Liquors

Liquors injected into the Veins *of Animals*; *by* S. Fraçaſſati. Phil. Tranſ. N° 27. p. 490.

S. *Fracaſſati* profeſſor of anatomy at *Piſa* in *Italy*, having injected ſome diluted *Aqua-fortis* into the jugular and crural veins of a dog, the animal died immediately; and being opened, all the blood in the veſſels was fixt, but that in the guts not ſo much; the great veſſels were obſerved to be burſt: Upon this experiment, the author makes the following reflections; firſt, that an apoplexy being often cauſed by a like coagulation of the blood, as has been obſerved in ſuch as died of this diſtemper, it might be cured by a timely infuſion of ſome diſſolvent into the veins; that it is likely, that M. *de Bilwſ*'s ſecret of diſſecting animals, without any effuſion of blood, conſiſted in ſome ſuch injection. He afterwards infuſed ſome ſpirit of vitriol into another dog, which had not ſo preſent an effect; for the animal complained a great while, and foamed like *Epileptics*, and breathed very thick; but dying at laſt, his blood was found fixt and grumous in the veins, reſembling ſoot. Upon injecting ſome oil of ſulphur into a dog, he died not, tho' it was ſeveral times repeated, and the wound being cloſed and the dog let go, he run into all the corners of the room ſearching for meat, and finding ſome bones, he fell a gnawing them with great voracioufneſs, as if this liquor had cauſed an extraordinary appetite in him: Injecting ſome oil of tartar into another dog, he complained much, became very bloated and died; being opened, his blood was not curdled, but thinner and more florid than ordinary; which ſeems to hint, that a too great thinneſs, as well as too great a coagulation of it, are equally noxious.

Diſcoveries concerning the Brain *and* Tongue; *by* S. Malpighi. Phil. Tranſ. N° 27. p. 491.

S. *Malpighi* pretends to have diſcovered, that the exterior and ſofter part of the brain covers not only the *corpus calloſum*, but inſinuates itſelf into it in many places; that the *corpus calloſum*, is nothing but a contexture of ſmall fibres, iſſuing from the *medulla ſpinalis*, and terminating in the exterior part of the brain; which fibres are ſo manifeſt in the ventricles of the brains of fiſhes, that when they are looked through, they repreſent the figure of an ivory comb: As to the uſe of the brain, he pretends that half or at leaſt a third of the blood of an animal being conveyed into it, its fineſt ſerum is filtrated thro' the exterior part, and then entring into the fibres of the brain, is thence conveyed into the nerves. S. *Malpighi* has been

been alſo very curious in examining the optic nerve in divers animals; and for this end he diſſected the head of a *Xiphias* or ſword-fiſh, whoſe eye is very large, and he was ſo far from obſerving any conſiderable cavity, either in the optic nerve or nervous fibres, that he found its middle to be nothing more than a large membrane folded up, according to its length, in many doubles almoſt like a fan, and inveſted by the *Dura mater*. *Euſtachio*, a famous anatomiſt, had written ſomething of this before, but obſcurely, and without mentioning the animal, wherein he obſerved it: *Malpighi* found that this ſtructure is peculiar to fiſhes alone, and not to be met with in land animals; for the optic nerve of an ox, pig, *&c.* is nothing more than a heap of many ſmall fibres of the ſame ſubſtance with the brain; wrapt up in the *Dura mater*, and accompanied with many ſmall blood veſſels: Hence he decides that grand queſtion among anatomiſts, whether the optic nerve be hollow or not; for he holds there muſt be many cavities in this nerve, in regard, the ſmall filaments it conſiſts of, cannot be ſo cloſely joined, as not to leave ſome void ſpace between them.

S. *Malpighi* has diſcovered ſeveral little eminences in the tongue, which he calls papillary, and takes them for the principal organ of taſte. It muſt not be omitted that S. *Fracaſſati* obſerved eminences towards its point, and cavities towards it root, that terminate in nerves, and ſeem to ſerve for funnels to convey the aliment unto them; whence he thinks it probable, that the fineſt part of the food paſſes immediately from the tongue to the nerves, and this is the reaſon that the mouth being frequently gargled with wine, preſently reſtores vigour.

An Obſervation on cold Blood; *by* S. Fracaſſati. Phil. Tranſ. N° 27. p. 492.

WHEN blood is become cold in a diſh, the lower part appears blacker than the top; and it is popularly ſaid, that the black part is melancholy blood; but S. *Fracaſſati* maintains that this darker colour is owing to the blood, that lies underneath, not being expoſed to the air; for upon doing that it changes colour, and becomes of a florid red.

Mercury *found at the Roots of Plants, and Shells on inland Mountains*; *by* S. Manfredus Septalius. Phil. Tranſ. N° 27. p. 493.

IN the valley of *Lancy*, which runs between the mountains of *Turin*, grows a plant, called *Doronicum* by the inhabitants and botaniſts, near whoſe roots you may find pure *Mercury*, run-

running in ſmall grains, like pearls; upon expreſſing the juice and expoſing it to the air of a clear night, there will be found as much quickſilver, as it loſt in juice.

In a journey to *Genoa*, over ſome mountains, he found many ſhells; as the turbinets, echins, and ſome pearl ſhells, one of which had a fair pearl in it.

Obſervations made in a Voyage from England *to the* Caribbe Iſlands. Phil. Tranſ. N° 27. p. 493.

THIS obſerver having remarked at *Deal* the great difference in the ruſting of iron in ſuch houſes as front the ſea, and in thoſe of the ſtreet immediately behind the former; he was told, that it ruſted more at high-floods, than at neap-tides; owing to the ſaline exhalations, being hindred by the height of the beach; and this reminded him of the vanity of the argument of M. *Ligons* and others, *viz.* that the air of the *Weſt-Indies* was hot and moiſt, becauſe of the ruſting of iron; whereas it proceeds from ſome other principle in the air; for at the point of *Cagua* in *Jamaica*, where it ſcarcely rains 40 times a year, iron ruſts as much or more than any where beſides; in *Jamaica* it ruſts leaſt in rainy weather.

The ſteams of the ſea are of ſuch a nature, that ſweet meats became rotten, ſugar of roſes and other lozenges grew moiſt, tho' there was no rainy weather; and ſuch pies and gammons of bacon, as kept well before, upon once being expoſed to the air, ſpoiled more in a day or two than in ſix weeks before.

At point *Cagua*, the iron guns of the fort were ſo corroded, that they were become almoſt uſeleſs, being perforated like honey-combs; and ſome pounds of ruſty iron could be ſtruck off with a hammer, but the guns that lay in ſalt water, were obſerved not to be much damaged.

Linens and ſilks, once expoſed to the air, become rotten; as alſo a lancet will ruſt, tho' you preſently put it up again; but if never expoſed to the air, it will hardly ruſt.

To preſerve ale, this obſerver was directed to put to every rundlet of five gallons, after it comes on board, two new laid eggs, whole, to remain therein; and he was told that in a fortnights time, the ſhells would be diſſolved, and the eggs become like wind eggs; and that afterwards, the white would diſappear, and the yolk remain untouched; by this means the ale kept all the way to *Jamaica*: If eggs be thus put in *March* beer after it has done working, they prevent its ever growing harſh.

The

The *Thames* water in eight months acquires ſuch a ſpirituous quality, as to burn like ſpirit of wine; and ſome *Eaſt India* ſhips have been in danger of being ſet on fire, by holding a candle near the bung, upon firſt opening the caſk; if you take the bung out of any caſk that ſtinks, in 24 hours it will become ſweet again; and if you ſtir it well about with a broomſtick, it will turn ſweet in four or five hours, letting fall a black lee, which remixes with it, and ſo cauſes a third or fourth fermentation and ſtench, after which it ſtinks no more.

He obſerved the falſehood of *Glauber*'s aſſertion, *viz.* that as the ſea grows ſalter it becomes greener; whereas, it is darker, and at laſt, becomes perfect azure, turning ſtill ſalter; for a water-poiſe of glaſs, with mercury at one end, roſe about $\frac{1}{2}$ inch above the ſea water in the *Downs*; and at 24 degrees more, two inches, but after that he never obſerved any difference all the way to *Jamaica*; and this refutes another aſſertion, *viz.* that the nearer the *Tropics* and the *Line*, the ſea is the ſalter.

He never obſerved the ſea to burn ſo much as that he could perceive fiſhes in it; the light was at ſometimes greater than at another; and at *Deal* it flamed more than in all the voyage, the water running off the oars like liquid fire; the wind was then ſouth-eaſt, for when it is at eaſt and ſouth, the ſea flames moſt.

Two contrary winds are obſerved to poiſe each other, and make a calm in the middle, ſhips at a diſtance ſailing with contrary gales at the ſame time.

Such places in the *Indies*, as have any high mountains, have every night a wind from the land. In *Jamaica* it blows by night off the iſland from all the points of the compaſs at once; ſo that no ſhip can either come in or go out, before the ſea-breeze early in the morning. As the ſun declines, the clouds will fall and gather about the mountains, and old ſeamen will tell you, towards evening, each iſland by the ſhape of the cloud over it; not only mountains, but other high parts, ſuch as trees, will alſo cauſe a collection of the clouds: *Barbadoes* has not now half the rain it had, when more woody; and in *Jamaica* the rains are diminiſhed as their plantations extend; in the harbour of *Jamaica* are many rocks of the ſhape of buck's or ſtag's horns; there are alſo ſeveral ſea-plants, whoſe roots are not ſtony, of which ſome are inſipid, and others perfectly nitrous, and a lime-ſtone gathers upon them; a Manchinel-apple, falling into the ſea, and lying in the water, will contract a *lanugo* or down of ſalt-petre.

It is commonly affirmed, that the ſeaſons of the year, between the *Tropics* are divided by the rains and fair weather, allotting ſix

months

months to each; but this obſervation holds not generally true; for as it was ſaid above, at the point of *Jamaica*, it ſcarce rains forty times a year, *viz* from *Auguſt* when they begin, to *October* incluſively; towards *Port-morant* and ſix miles from the point, for eight or nine months, beginning from *April*, ſcarce an afternoon paſſes but it rains: At the *Spaniſh* town it rains only for three months in the year, and then not much: It rains not at *Barbadoes* at the ſame time it rains at *Mevis*: At *Cignateo*, othewiſe called *Eleutheria*, in the *Gulf* of *Bahama*, it rains not ſometimes in two or three years, ſo that this iſland has been twice deſerted for want of rain.

At the point of *Jamaica*, wherever you dig five or ſix foot, you will find water, which ebbs and flows as the tide; it is not ſalt but brackiſh, unwholeſome for men, but good for hogs; at the *Caymans* there is no water but what is brackiſh, yet it is wholeſome, and many ſick people are recovered there, who feed on *Tortoiſes* and drink no other water.

The blood of *Tortoiſes* is colder than any water there, yet the beating of the heart is as vigorous as that of any animal, and their arteries as firm; their lungs lie in their belly, below the diaphragm, extending to the extremity of their ſhell; their ſpleen is triangular, of a firm fleſh, and of a florid red; their liver is of a dark green, inclining to black; they have a ſort of teeth in the *Oeſophagus* or gullet, with which they chew the graſs growing in the meadows, at the bottom of the ſea: All the *Tortoiſes*, from the *Carribees* to the *Bay* of *Mexico* and *Honduras*, repair in ſummer to the *Cayman Iſlands*, to lay their eggs and hatch there; they coot for 14 days together, then lay upwards of 300 eggs in one night, with white and yolk, but no ſhells; then they coot again, and lay in the ſand, and thus for three times; after which the male is reduced to a kind of jelly, becomes blind, and is in that manner carried home by the female; their fat is green, but not offenſive to the ſtomach; the urine of the perſon that eats it, looks of a yellowiſh green, and is oily.

At the point there is no other ſoil, beſides ſand; yet melons, muſk, and water-melons thrive admirably well there, beſides a great many trees, eſpecially mangranes and prickle-pears; and one may ride thro' whole woods, that have no earth, but firm rock to grow in.

In ſome ſoil full of ſalt-petre, and where tobacco grows, that tobacco will flaſh in ſmoaking.

Fruit trees of the ſame kind ripen not at one and the ſame time; ſome are obſerved in flower, others with green, and others

with ripe fruit: The ſower-ſop has a flower with three leaves, which on opening, make ſo great an exploſion, that this obſerver ſays, he more than once run away from under the tree, thinking it would tumble down.

There is a bird, called a pellican, but a kind of cormorant, of a fiſhy reliſh, but if it lie buried in the ground for two hours, it will loſe that taſte.

Upon analyzing bodies by expoſing them to ants, it was found, that they would eat brown ſugar, till it became white; and at laſt reduce it to an inſipid powder; and a pound of ſallet oil to two drams of powder.

On our firſt landing in *Jamaica*, we ſweat continually in great drops for three quarters of a year, and then it ceaſes; and in all that time, one is neither more dry, more coſtive, nor makes leſs urine, than in *England*; nor does ſo great a diſcharge by ſweat make one faintiſh; and if one is dry, as it is generally a thirſt ariſing from the heat of the lungs, and affecting the mouth, it is beſt cooled by a little brandy.

Moſt animals drink little or nothing there, as hogs; nay, horſes in *Guanaboa* never drink; nor cows, in ſome places of the iſland, for ſix months; goats drink, perhaps, once a week; but parrots and perroquets never, and civet cats only once a month.

The hotteſt time of the day, is about eight in the morning, when there is no breeze; upon ſetting a weather glaſs in the window, it did not riſe conſiderably then, but about two it roſe two inches.

Venice treacle was ſo dry in a galley pot, as to be friable; and then it produced a fly, called a weevil, and a ſort of white worm; the *pillulæ de tribus* produced alſo a weevil.

To conclude, there is a plain in the middle of the iſland, called *Magotti Savanna*, where when it rains, the drops as they ſettle on the ſeams of any garment, in half an hour become maggots.

Some magnetical Experiments; *as alſo an Account of an excellent* Liquor; *by Mr.* Colepreſs. Phil. Tranſ. N° 27. p. 500.

MR. *Colepreſs* took an unpoliſhed loadſtone, of a weak attractive power; and he heated a lath-nail glowing hot, nimbly applying the north pole of the magnet to it, it quickly took it up, and held it ſuſpended a great while; he threw the ſame ſtone into the fire, till it was thorough hot, and he applied the north pole to another cold lath-nail, that was

was untoucht before, which it took up but faintly, yet held it ſuſpended for ſome time. Two or three days after, he took the ſame loadſtone, and found it attract as ſtrongly, as before it was caſt into the fire; whence he inferred, that the fire leſſened ſomewhat the attractive power, but did not entirely deſtroy it.

The liquor, mentioned in the title, is a compoſition of good cyder-apples and mulberries, affording the moſt palatable liquor, with the fineſt tincture imaginable.

A Method of transfuſing Blood *into the Veins of Men*; *by Sir* Edm. King. Phil. Tranſ. N° 28. p. 522.

THE transfuſing of blood having been with facility enough practiſed upon animals; Dr. *King* gives here an account of a proper apparatus for performing the ſame on men, which is only a ſilver tube, with a ſtopper of the ſame metal, ſomewhat blunted at one end, and flat at the other, for the conveniency of handling it: The method in ſhort is this; after the artery is prepared in the lamb, kid, *&c.* make a ligature on the arm, *&c.* of a man, where you intend to inſert the ſmaller end of the ſilver pipe; divide the ſkin of the part, in the ſame manner as is uſed in cutting for an iſſue, exactly over the vein to be opened; then with a fine lancet open the vein; or if the vein lie fair and high, and the ſkin be fine, you may open both at the ſame time, as is uſual in letting blood; after which, let an aſſiſtant clap his finger, or a little bolſter upon the vein, a little below the orifice, to hinder the blood from aſcending; then inſert the tube upwards into the vein, and hold it and the ſkin cloſe together, between your finger and thumb; after this, pull out the ſtopper of the tube, and inſert the pipe, by which the arterial blood is to be transfuſed from the emittent animal; and then proceed as is uſual in this experiment.

The *French* pretend that it was they who gave the *Engliſh* the firſt notion of transfuſion; but they differ as to the inventor, ſome fathering it on the abbot *Bourdelot*, and others on *Dom Robert Gabets*, a *Benedictin* friar; beſides, they cannot ſhew any publick records either written or printed, of the time and place of the invention, the method of practiſing it, or the ſucceſs in the execution; but in N° 7. p. 128 of theſe Tranſactions, is an account of Dr. *Chriſtopher Wren*'s invention of making injections into the veins of animals, which was a ſufficient hint to the Royal Society, to change *Infuſion* into *Transfuſion*; and accordingly at a publick meeting, *May* 17th, 1665, they gave orders about the trial of the latter; but the attempt proved

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insuccessful then, for want of a fit apparatus, and a proper method of operation; which Dr. *Lower*, some time after, found out, and of which an account is given N° 20. p. 353, he having already practised it at *Oxford* before that time, wherein he was followed by several ingenious men at *London*.

The Mendip Lead Mines *in* Somersetshire; *by Mr.* Jos. Glanvil. Phil. Trans. N° 28. p. 525.

MENDIP is all mountainous; it is also barren, cold, and rocky in some places; its ridges run confusedly, but generally east and west; its surface is heathy, ferny, and furzy; the cattle that feed on it, for the most part, are sheep, which go there all the year; and young beasts, horses, and colts at spring and fall; the sheep are not fair, but big-bellied, and they grow not to any bigness, after feeding there; and so of their beasts and horses: The Inhabitants are healthy, and live to the ordinary age, except such as are employed in melting the lead at the mines, who, if they work in the smoke, are subject to a disease that proves mortal, which is also the case of the cattle that feed thereabouts: There are many wholesome springs at the foot of the hills, which, after running some distance, form rivers; the air is moist, cold, foggy, thick, and heavy: The soil near the surface is red and stony; and the stones, are either fire-stones or lime-stones, but there is no clay, marl, or chalk: The tops of the trees, that grow there, are burnt, their leaves and outsides discoloured and scorched with the wind, and the trees themselves grow neither big nor tall; the stones and peebles, that are washed by the brooks and springs, are of a reddish colour, and ponderous: Snow, frost, and dew continue longer on *Mendip* then on any of the neighbouring grounds: Thunder and lightning, storms, *ignes fatui*, and fiery meteors, are very frequent there: The ore lies in veins in a heap, and is perfect lead, only, on the outside, coated with a reddish earth; in some places it is deeper, in others shallower, in some narrower, and in others broader: The ore is beaten small, and washt clean in running water, and then sifted in iron rudders; the hearth or furnace is made of clay or fire stones, and on it they build the fire, which is lighted with charcoal, and fed with young oaken *gadds*, and blown with bellows, by men's treading on them; and after the fire is kindled, and the hearth hot, the ore is thrown upon the wood, and it melts down into the furnace; then they take it out with iron ladles, and cast it upon sand into what form they please.

Magne-

Magnetical Variations; *by M.* Petit. Phil. Tranſ. N° 28. p. 527.

THE ingenious author, in his letter to Mr. *Oldenburg*, owns that nothing can be more agreeable to him than to diſcourſe on this ſubject, and eſpecially to *Engliſh* philoſophers, to whom the philoſophy of the magnet owes its riſe, and who have been the chief obſervers of its variation; he therefore thinks it a juſt tribute, that all the obſervations, made elſewhere, ſhould return to *England* as to their ſource.

M. *Petit* traced three ſeveral meridians in three ſeveral places of *Paris*, and found the declination of the needle 4 ½° north eaſt; before which, ſome following *Orontius Fineus* and *Caſtlefranc*, made it 9 or 10°; others, after *Sennertus* and *Offuſius*, 11 ½°.

Mr. *Gilbert*, the firſt who writ rationally on the magnet, aſſerts towards the end of his book, that if a round magnet were placed in the meridian, and conſequently, its poles and axis in the direction of thoſe of the world, it would continually turn round, compleating its revolution in 24 hours; whence, he infers, that the whole earth, as a great magnet, revolves round its axis in the ſame time; in order to try the truth of this propoſition, M. *Petit* cauſed a magnet to be turned with the powder of emery, into an exact ſphere of 1 ½ inch in diameter, whoſe three centers of magnitude, gravity, and magnetiſm were the ſame; after finding the two poles of this ſtone he cauſed two ſmall holes to be made therein, that it might hang by two points of needles, as by two pivots; putting 'em into a braſs meridian, and ſuſpending the ball betwixt them, like a little globe, it was ſo eaſily moveable, that the leaſt breath could turn it round; the ſucceſs was, that it had not any motion of itſelf; for a ſmall white mark, he had made upon the ſtone, remaining in the ſame place, ſeemed ſufficiently to refute this notion: But tho' this magnetical globe did not anſwer the former deſign, yet it was very uſeful in determining, whether needles, touched in different parts of it, had different declinations; and on repeated trials with this and other ſtones, he obſerved no difference at all, but that all the needles declined 4 ½ degrees from the north eaſtward; and he found it to be the ſame in many places from *Breſt* in *Britany*, to the *Valtoline* among the *Alps*; on which account, he thought the ancients had ill obſerved the variation; but he was ſoon undeceived by the obſervations made in *England*; for Mr. *Burrows* had obſerved it in 1580, near *London*, to be 11°, 11′;

and

and Mr. *Gunter*, in 1612, found it reduced to 6° in the ſame place; and Mr. *Gellibrand*, in 1633, found it only 4° north-eaſt; whence it appeared, that theſe declinations were not conſtant; and to ſatisfy himſelf, he made ſeveral experiments; particularly in *June* 1660, exactly tracing a meridian, and applying good needles upon it, the one, ſeven, the other, ten inches long, he found they declined about a degree; and in 1666, the declination was only 10′ on the ſame meridian; and in 1667, it was ſtill leſs, but yet ſome minutes to the eaſt of *Paris:* And he doubts not but in 12 or 15 years, the declination will be 1 $\frac{1}{2}$° north-weſt; for according to his hypotheſis, the declination varies a degree every ſeven or eight years.

Obſervations on a great Fiſh *and a* Lyon, *diſſected in the King's Library at* Paris. Phil. Tranſ. N° 28. p. 535.

THIS great fiſh, diſſected by the *Pariſian* philoſophers, was a *Vulpecula marina*, or ſea fox: The length of his tail was nearly equal that of his whole body beſides; the whole fiſh was 8 $\frac{1}{2}$ foot long, and in ſhape reſembling a ſcythe, bent and arched towards the belly: His mouth was armed with two ſorts of teeth; that in the upper jaw, being pointed, hard and firm, and of one entire piece of bone, like a ſaw; the other ſort, found in the remaining part of the upper, and in the whole under jaw, was moveable, and faſtened by fleſhy membranes; his tongue adhered entirely to the lower jaw; its ſkin was hard and covered over with little ſhining points, which made it very rough, and viewed with a microſcope, they appeared tranſparent like cryſtal; his throat was very wide, and his *Oeſophagus* or gullet as large as his maw; and authors relate, that he has the dexterity of diſengaging himſelf from the ſwallowed hook, by caſting it up together with his maw, the inſide turned out; they found in his maw the ſea herb *Varec*, five inches long, and a fiſh of the ſame length, without head, ſcales, ſkin, or guts, all being waſted to the muſculous fleſh, which remained entire: The upper part of his great gut had this in peculiar, that inſtead of the uſual circumvolutions of guts, the cavity of this was divided tranſverſly by many partitions, conſiſting of the membranes of the guts turned inwards, and in the form of a vice, ſnail-ſhell, or winding ſtairs; his ſpleen was double; his liver divided into two lobes; the gall more bitter than ſour; the heart without a pericardium, as big as a hen's egg; the head almoſt nothing but a maſs of fleſh, with little brains, and theſe had very few meanders or windings;

ings; the eyes bigger than thoſe of an ox, hemiſpherical, and flat before; the *Sclerotica* was formed like a cup, very thin, but very hard; the *Cornea* very tender and ſoft; the cryſtalline perfectly ſpherical; the *Uvea* greyiſh; the *Choroides* of the ſame colour, and with a large perforation for the production of the *Retina*; the bottom of this *Choroides* had that luſtre of mother of pearl, obſervable in land animals, but the colours leſs vivid, and the *Retina* was alſo ſtreaked with blood veſſels that appeared very plain.

In the lyon they obſerved in general, that, in outward ſhape, and in the ſtructure of many parts, as the claws, teeth, eyes, tongue, beſides the reſemblance of the *Viſcera* or bowels, he is very much like a cat: In particular, they obſerved the admirable ſtructure of his claws, the peculiar ſhape and poſition of his teeth; a very ſtiff neck; his tongue very rough and ſharp, with points, like claws, both for hardneſs and ſhape; his eyes very clear and bright, even in death; the eyes of lyons, like thoſe of birds and cats, are furniſhed with a thick and blackiſh membrane, ſituated in the great angle, and extending over the whole *Cornea*, reaches to the ſmall angle of the eye; the ſide of the *Uvea*, next the cryſtalline, is entirely black; the cryſtalline itſelf is very flat; and its greateſt convexity, in the anterior part, as in cats; the aqueous humour very plentiful, equalling almoſt a ſixth part of the *Vitreous*; and this plenty was thought the cauſe of their brightneſs after death: His throat was not above 1 ½ inch wide; his ſtomach 6 inches wide, and 18 inches in length, and the guts 25 foot long; the liver divided into lobes, as in cats; its cavity, under the gall-bladder, was full of gall, which was ſuppoſed to be the cauſe of this lyon's death: The gall-bladder was 7 inches long, and 1 ½ large, and of a peculiar ſtructure; the ſpleen a foot long, two inches wide, and an inch thick; the kidney weighed a little more than ſeven ounces; the genitals were of a peculiar conformation, cauſing this animal to diſcharge his urine backwards, and to couple like camels and hares: His lungs had ſix lobes on the right ſide, and three on the left; the annular cartilages of the windpipe were entire, excepting two or three; it was above four inches in compaſs, and very firm, both which, account for the dreadful roaring of this animal: His heart was dry, and no water in the pericardium; greater, in proportion, than that of any other animal's, being ſix inches long, and four inches broad at the baſis, and terminating in a ſharp point;

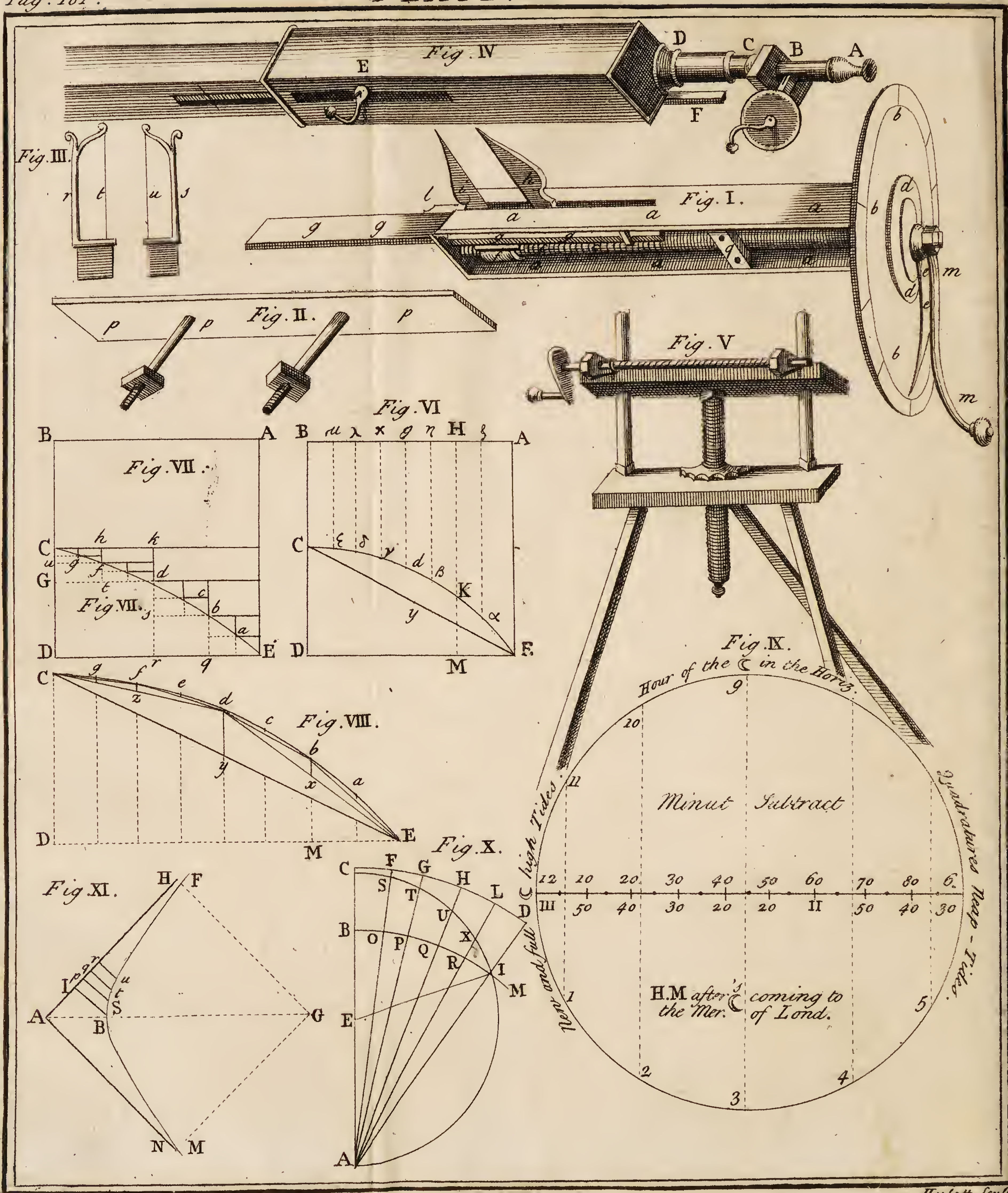
point; it had very little flesh, and was all hollow, with the ventricles very large, and the auricles very small; the carotids were as big as the subclavian branches, a very great proportion, considering the bulk of the brain, which was but two inches any way; the rest of the head was very fleshy, and consisted of firm bones; by comparing the smallness of the lion's brain, with the great bulk of a calf's, it was judged, that the having a small quantity of brains, is rather a sign of fierceness and cruelty, than want of wit.

An Experiment of preserving Animals *alive, by blowing into their Lungs with Bellows; by Dr.* Hook. Phil. Trans. N° 28. p. 539.

DR. *Hook*, on displaying the thorax of a dog, by removing the ribs and diaphragm, and cutting his *Aspera arteria* or wind-pipe, just below the *Epiglottis*, which he fastned on the nose of a pair of bellows, kept the dog alive, by the reciprocal blowing up of his lungs; for by intermitting to blow, and suffering the lungs to subside, the dog fell into convulsions, but, upon inflating the lungs a-new, he was suddenly revived; the Dr. caused another pair of bellows to be joined to the first, and pricking all the external coat of the lungs with the slender point of a sharp penknife; this second pair was moved very quick, whereby the first pair was always kept full, and always blowing into the lungs, which became motionless, being thus kept distended, as fast as the air escaped by the prickt holes in the external coat; and the event was, that the dog lay still, his eyes moving very quick, and his heart beating very regularly; but on intermitting to blow, and suffering the lungs to subside, the dog would fall into dying convulsions, and be again as soon revived by the inflation of fresh air: Towards the end of this experiment, a piece of the lungs was quite cut off; when, it was observable, that the blood freely circulated thro' them, not only, when distended with wind, but also, when suffered to subside: Which seems to prove, that as the bare motion of the lungs, without fresh air, contributes nothing to the life of the animal, he being found to live, as well when they moved, as when not; so the want of motion in the lungs, was not the immediate cause of death, or of stopping the circulation thro' the lungs, as some eminent physicians had affirmed, but the want of a sufficient supply of fresh air.

A De-

PLATE. IV.



Hulett Sculp

A Defcription of Mr. Gafcoigne's Micrometer; *by the fame.* Phil. Tranf. N° 29. p. 541.

IN Pl. IV. F. 1. *aaaa* is a fmall oblong brafs box, ferving both to contain the fcrews, and their fockets, or female fcrews, and by which it is fixed to the telefcope, and to make the feveral moveable parts of the inftrument move very true, fmooth, and in a fimple direct motion; a round plate of brafs *bbbb*, about three inches over, is fcrewed on to one end of it; the extreme limb of whofe outfide is divided into 100 equal parts, and numbered 10, 20, 30, &c. thro' the middle of this plate, and that of the box *aaaa*, goes a fcrew very curioufly wrought, and about the bignefs of a goofe-quill, and of the length of the box, whofe head is fo fitted to the plate by a fixt ring, on the infide, and a fmall fpringing plate *dd*, on the outfide, that it is not in the leaft fubject to fhake; the other end of this fcrew is fixed and made fteady in the box by another little fcrew, whofe fmall points fill the centre or hole, made in the end of the longer fcrew for this purpofe; a fmall index *ee*, is fitted to the head of the fcrew without the fpringing plate, and above that, a handle *mm*, to turn the fcrew round, as there fhall be occafion, without any danger of difplacing the index, it being put very ftiff on a cylindrical part of the head, and the handle on a fquare; that third of the fcrew, next the plate, is bigger than the other two thirds, by, at leaft, the depth of the fmall fcrew; the thread of the fcrew of the bigger third is as fmall again, as that of the fcrew of the other two thirds; to the greater fcrew a focket *f* is fitted, fixt to a long bar or bolt *gg*, on which is faftened the moveable fight *h*, fo that every turn of the fcrew promotes the fight *h*, either a thread nearer, or farther off from the fixt fight *i*; the bar *gg* is made exactly equal, and fitted to two fmall immoveable ftaples *kk*; there are 60 of thefe threads, and on the edge of the bolt or ruler *gg* are made 60 divifions anfwering to them, and a fmall index *l* fixt to the box *aaaa*, denotes, how many threads, the edges of the two fights *h* and *i* are diftant; and the index *ee* fhews on the circular plate, what part of a revolution there is over; every revolution, as was faid, being divided into 100 parts. At the fame time, that the moveable fight *h* is moved forwards or backwards, one or more threads of the coarfer fcrew, the plate *pp*, fig. 2, is moved forwards or backwards, fo many of the finer fcrew, by means of the focket *q*, to which it is fcrewed: This plate is to be fixed to the telefcope by the fcrews

ſcrews *rr*, ſo as the middle betwixt the ſights may lie in the axis of the glaſs, and they either equally open from it, or ſhut towards it, in what manner ſoever the ſcrew is turned: Inſtead of the edges of two ſights *h* and *i*, ſome prefer thoſe fitted with hairs, therefore fig. 3. repreſents two ſights *r* and *ſ*, ſo fitted with threads *t* and *u*. Fig. 4. repreſents how the ſcrews are to be put on; the tube A D is divided into three lengths, of which B C is to be lengthened or ſhortened, as the object requires; but A B is here added, that at A, you may put ſuch eye-glaſſes, as ſhall be thought moſt convenient, and in order to ſet them at the propereſt diſtance, there are indexes ſuppoſed to be at B; E is a ſcrew, for fixing the great tube in ſuch a manner, as by the help of the figures, any ſmaller part of it may immediately be found, meaſuring only, or knowing the diviſions on BC, the diſtance of the object-glaſs from the indexes; F is the angular piece of wood, lying on the upper ſcrew of the reſt; and this reſt is repreſented by fig. 5.

Dr. *Hook* ſuggeſts, that this reſt may be rendred more convenient, if, inſtead of placing the ſcrew horizontally, it be ſo contrived, as to lie parallel to the equinoctial, or the earth's diurnal motion; for, by that means, the ſame thing may be done by the ſingle motion of one ſcrew, which in the other way cannot be done, but by the turning of both ſcrews.

An Experiment concerning the Manner of Reſpiration; *by Dr.* Lower. Phil. Tranſ. N° 29. p. 544.

AFTER the doctor had often conſidered the manner of reſpiration, he was induced by many obſervations to think, that the diaphragm or midriff is the chief organ therein; and to evince this, nothing ſeemed more probable than cutting the nerves, whereby its motion is performed; which accordingly he did, in the following manner: He made a perforation in the ſide of the animal, between the 6th and 7th ribs, in the middle of the thorax, juſt over-againſt the region of the heart, with a ſmall inciſion knife, going no deeper than juſt the cavity of the breaſt; then taking it out, he put in a director, or a ſmall quill, thruſting it in about an inch, and directing the end of it towards the *Sternum*, cloſe to the inſide of the breaſt; and he cut upon it about an inch on the intercoſtal muſcles; this done, he put in his finger, and with his nail ſeparated the nerve, that paſſes along the ſide of the pericardium towards the diaphragm; then he put in a probe, a little bent at one end, like a hook, and laid hold of the nerve, pulled it to the ori-

orifice in the breaſt, cut it off, and ſowed up the wound very cloſe; the ſame thing being done on the other ſide, and the dog preſently let looſe, he obſerved him draw his breath, like a wind-broken horſe.

The moſt obvious obſervations from this experiment are, 1. That the action of reſpiration is quite altered; for, as in a ſound animal, the belly ſwells in inſpiration, by the diaphragm, in its contraction, acting on the bowels; and again in expiration, the belly ſubſides, upon its relaxation; ſo in a wind-broken horſe or dog, it is quite the reverſe. 2. It being certain, that the lungs do not move of themſelves, but wholly depend upon the expanſion of the thorax, by the intercoſtal muſcles and diaphragm; from this experiment, it appears, how much each of them a-part contribute to reſpiration; for, inſpiration being performed by the dilatation of the thorax, and that dilatation ariſing, partly, from the intercoſtal muſcles elevating the ribs; and partly, from the diaphragm, by its contraction, depreſſing the lower ſmall ribs, in which it is inſerted, together with the *Viſcera* of the lower belly; and by their joint action, making all the ſpace they can, for the intromiſſion of air to diſtend the lungs; when one of theſe agents is made incapable of performing its part, the other muſt exert itſelf the more to ſupply that defect; and this is evident to ſenſe, for the diaphragm being rendred uſeleſs, by cutting its nerves, the intercoſtal muſcles elevate the ribs to a greater pitch than they did before. 3. The manner of reſpiration, being the ſame in a dog, whoſe diaphragmatic nerves are cut, and in a wind-broken horſe, it is more than probable, that the cauſe may be the ſame; or at leaſt, that this weakneſs might at firſt ariſe from either a relaxation or rupture of theſe nerves.

The Effects of mixing ſeveral Liquors *with the Blood, as it came warm from the Veins; by Mr.* Boyle. Phil. Tranſ. N° 29. p. 551.

THE honourable Mr. *Boyle*, in a letter dated *Octob.* 19th, 1667, on occaſion of the experiments about injections, by S. *Fracaſſati*, publiſhed N° 27. p. 490, informs Mr. *Oldenburg*, that about three years before, he had mentioned at *Greſham* college to the Royal Society, an odd experiment on warm blood, as it came from the animal, *viz.* That by putting into it a little aqua-fortis, or oil of vitriol, or ſpirit of ſalt, the blood would not only loſe its pure colour and become dirty, but be in a moment coagulated; whereas, if ſome fine urinous

ſpirit, abounding in volatile ſalt, ſuch as ſpirit of ſal-armoniac, were mingled with the warm blood, it would be ſo far from curdling it or debaſing its colour, that it would rather make it look more florid than before, and both keep it fluid, and preſerve it from putrefaction for a longer time; and that he deviſed this experiment to ſhow the amicableneſs of volatile ſpirits to the blood; and poſſibly from this S. *Fracaſſati* might take the hint of injecting ſuch liquors into the veins of animals.

Mr. *Oldenburg* confirms this relation, it appearing from the journals of the Royal Society that the honourable Mr. *Boyle* had communicated to them the above experiments in *Dec.* 1664.

An Obſervation on the Epiploon *by* S. Fracaſſati *and* Malpighi. Phil. Tranſ. N° 29. p. 552.

THE *Epiploon*, or caul, being viewed with a good microſcope, reſembles a great ſack, furniſhed with other ſmall ones, which contain collections of fat; there are many veſſels, which may be called *adipoſe* or fatty, iſſuing out of this membrane, which ſpreading themſelves all over the body, convey fat to it, in the ſame manner, as the arteries do the blood; wherever fat is found, there are alſo numbers of theſe little ſacks obſerved, wherein this fat is contained; whence it is, that in lean and emaciated bodies, inſtead of fat, you find nothing but empty ſkins, or veſicles. The ſtructure of theſe *ſacculi* and of the adipoſe veſſels ſufficiently ſhows, that the fat is not formed by chance, out of the thick vapours of the blood, as is commonly thought; nor, that its chief uſe is to cheriſh the natural heat, it ſeeming rather to conduce to the allaying the acrimony of the ſalts in the blood and ſeroſities; for lean perſons, and ſuch as have had their caul cut out, are more ſubject to rheumatiſms, lienteries, and the like diſeaſes, that ariſe from the ſharpneſs of humours, than fat people.

Of Orange *and* Citron Trees *and their* Fruit. Phil. Tranſ. N° 29. p. 553.

AT *Florence* they have orange-trees, that bear a fruit, which is citron on one ſide and orange on the other; and this is alſo confirmed by an ingenious *Engliſh* gentleman who had ſeen of them at *Paris*, and a Provincial there pretends to keep orange-trees all the winter long, without any fire, tho' they remain in the earth; and are not put in boxes: This is thought to be done by a peculiar ſort of dung, uſed for that purpoſe, and wrought deep into the ground. And why might not this experiment

ment be made about *London*, whoſe latitude is much the ſame with *Paris?*

Transfuſion practiſed on a Man *in* London; *by* Dr. Lower *and* Sir Edm. King. Phil. Tranſ. N° 30. p. 557.

THIS experiment was performed on Mr. *Arthur Coga*, *Nov.* 23d, 1667, after this manner; having prepared the carotid artery in a young ſheep, and opening a vein in the man's arm, with as much eaſe as in common phlebotomy, he was bled ſix or ſeven ounces; then inſerting quills into the two pipes in the two ſubjects, to convey the ſheep's arterial blood into the man's vein, it ran freely for two minutes, and a pulſe was obſerved in the vein beyond the end of the ſilver pipe, and it was thought, he received nine or ten ounces of blood; for at firſt letting the ſheep's arterial blood run into a porringer for a minute, in that time there was a diſcharge of 12 ounces, but the pipe inſerted into the vein, being $\frac{1}{3}$ leſs than that thro' which the 12 ounces ran in a minute, we may ſuppoſe the quantity of blood received to be as above. The patient found himſelf very well, both in, and after the operation.

Medicated Liquors *injected into human* Veins; *by Dr.* Fabritius. Phil. Tranſ. N° 30. p. 564.

DR. *Fabritius* injected by a ſyphon, about two drams of a laxative medicine into the median vein of the right arm of three patients in the hoſpital at *Dantzick*; one of them was a robuſt ſoldier dangerouſly infected with the venereal diſeaſe, having nodes on the bones of his arms: Upon injecting the liquor, he complained of great pains in his elbows; about four hours after, it began to work, and the patient had five ſtools; and without any other medicines the protuberances diſappeared, and the diſeaſe was entirely removed. The two other experiments were made on a married woman of 35, and a ſervant maid of 20 years of age, both of whom had from their birth been afflicted with epileptic fits: They both underwent this operation, and there was injected into their veins a laxative roſin diſſolved in an anti-epileptic ſpirit; ſome hours after the injection, the former of theſe had gentle ſtools, and the next day the fits recurring, were much milder, and are ſince altogether vaniſhed. The other, *viz.* the maid had the ſame day four ſtools, and ſeveral the next day; but going into the air, taking cold, and not obſerving any diet, ſhe ſickened and died. It is obſervable, that after the injection, they all three had violent and frequent vomitings.

Of the Tides, Wells; *of* fresh *and* salt Water, *and of the* Whale Fishing, *&c. at* Bermudas; *by* Mr. R. Norwood. Phil. Transf. N° 30. p. 565.

IT is high water at *Bermudas* about seven o'clock at new moon, and in some creeks an hour or two later: The water rises but little, as about four foot at high-water, but at the spring-tides, it may be about a foot more; the tides without are very various in their setting; sometimes the tide of flood sets to the eastward sometimes to the westward; but in fair, calm and settled weather, the said tide sets from the south-east to north-west.

Wells of fresh water are sometimes dug within 20 yards or less of the sea, which rise and fall with the tides, as do most of the wells in the country, tho' further up. They dig till they come almost to a level with the surface of the sea, and then they find either fresh or salt water; if fresh, on digging two or three foot deeper and often fewer, they come to salt water: If it be a sandy soil or a sandy crumbling stone, thro' which the water gently filtrates, they usually find fresh water, but if hard lime-stone rocks, between whose chinks the water passes it is salt or brackish.

The whales of *Bermudas* are less than the *Greenland*, but swifter and more lively, so that when struck in deep water, they presently plunge with such violence, that the boat is in danger of being pulled down after them, unless the rope be timely cut; on which account, they usually strike them in shallow water; their boats are very stout and good, with six oars, and they can row them forwards or backwards, as they have occasion; and if they row up gently to the whale he will hardly avoid them; in the mean time the harpineer taking his opportunity, strikes his harping-iron about or before the fins, rather than towards the tail; these harping-irons are much like those used in *England* in striking porpoises, and they are of extraordinary good metal, that will not break, but wind about a man's hand; to the harping-iron a strong lithe rope is fastened, and a staff is put into its socket, which when the whale is struck, comes out; and sometimes they strike another iron, or dart lances till they have killed him. Mr. *Norwood* could not tell whether they found any *Spermaceti* in these whales, as they do in those of the *Bahama* islands; which latter, yielding not so much oil as the whales of *Bermudas*, are furnished with great teeth and are very strong.

To

To find the Year of the Julian Period; *by* R. P. de Billy, *and the demonstration of that method*; *by* Mr. J. Collins. Phil. Tranſ. N° 30. p. 568.

MUltiply the ſolar cycle by 4845, and the lunar by 4200, and that of the indiction by 6916; then divide the ſum of theſe products by 7980, which is the *Julian* period; the remainder of the diviſion, without regarding the quotient, will be the year of the *Julian* period required; *e. gr.* let the cycle of the ſun be 3, of the moon 4, and of the indiction 5, multiply 4845 by 3 and you have 14535, and 4200 by 4, and the product is 16800, and 6916 by 5, gives 34580; the ſum of the products is 65915, which divided by 7980, gives 8 for the quotient, and the remainder, 2075, is the year of the *Julian* period.

The *Julian* period is a baſis, whereon to found chronology, not liable to controverſy, as the age of the world is, and it is the number 7980 which is the product of 28, the ſolar cycle; into 19, the lunar cycle; and into 15, the indiction: Archbiſhop *Uſher* informs us, that *Robert Lotharing*, biſhop of *Hereford*, firſt obſerved the advantages thereof; 500 years after whom, it was fitted for chronological uſes by *Joſeph Scaliger*: This period is ſuch a limitation to chronology, that in 7980 years, the number of the ſun's cycle, the prime and the year of the *Roman* induction, which relates to their ancient laws and records, can never happen alike; biſhop *Uſher* ſuppoſes it to exceed the age of the world by 709 years.

The problem may be thus propoſed; any number of diviſors, together with their remainders after diviſion being given, to find the dividend: This problem was long ago reſolved by *John Geyſius*, by the help of particular multipliers, ſuch as thoſe abovementioned, and theſe fixt multipliers are defined to be ſuch numbers, as divided by the other diviſors, or their product, the remainder is 0; but divided by their own diviſor, the remainder is an unit. It is required that the given diviſors be primes to each other, *i. e.* that no two or more of them can be reduced to leſs terms by any common diviſor: For, if ſo, the queſtion may be poſſible in itſelf, but not reſolvable by help of ſuch multipliers, ſuch being impoſſible to be found; and the reaſon is, becauſe the product of an odd and even number is always even, and that divided by an even number leaves either nothing or an even number.

$$\text{Diviſors}\ \left.\begin{matrix}28\\19\\15\end{matrix}\right\}\ \text{The multipliers relative to them are}\ \left\{\begin{matrix}4845\\4200\\6916\end{matrix}\right.$$

The

The definition affords ſufficient light for the diſcovery of theſe numbers; to inſtance in the firſt, the product of 19 and 15 is 285, which multiply ſucceſſively by all numbers, and divide by 28, till you find the remainder required: Thus, twice 285, is 570, which divided by 28, the remainder is 10; alſo thrice 285 is 855, which divided by 28, the remainder is 15. Thus if you try on ſucceſſively, you will find that 17 times 285, which is 4845, is the number required, which divided by 28, the remainder is an unit; hence we ſhall find that

$$\left.\begin{matrix}4845\\4200\\6916\end{matrix}\right\}\text{ is equal to the ſolid, or product of }\left\{\begin{matrix}19,\ 15,\ 17\\28,\ 15,\ 10\\28,\ 19,\ 13\end{matrix}\right.$$

For the demonſtration of this rule we argue thus:

I. Each multiplier multiplied by its remainder, is divided by its own diviſor, leaving that remainder; for, each multiplier was defined above to be a multiple of its own diviſor, + an unit: Wherefore multiplying it by its remainder, only renders it a greater multiple to the ſaid diviſor, + an unit multiplied by the remainder, which is no other than the remainder itſelf, but if 0 be the remainder, that product is deſtroyed.

II. The ſum of the products, divided by each reſpective diviſor (by 1.) leaves its own proper remainder; for the firſt product is meaſured by its own diviſor, leaving its proper remainder; and if we add thereto the reſt of the products, we only add a multiple of its own diviſor, which encreaſes the quotient but not the remainder: In particular the ſecond multiplier is $28 \times 15 \times 10 \times$ remainder, all which is but a multiple of 28; and ſo the third product, is $28 \times 19 \times 13 \times$ remainder; and what has been ſaid concerning the ſum of the products, being divided by the firſt diviſor, and leaving its proper remainder, may be ſaid of each reſpectively.

III. The ſum of the products divided by the ſolid of the three diviſors, leaves a remainder qualified like that ſum: For that ſum (by 2.) is no other, than the firſt product encreaſed by adding a juſt multiple of the firſt diviſor, which enlarges the quote, but alters not the remainder; by parity of reaſon, the ſubtracting a juſt multiple thereof, alters only the quote, not the remainder; but the ſolid of all the three diviſors, multiplied here by the quote, as there by the remainder, is no other than a juſt multiple of the firſt diviſor; wherefore the remainder, after this diviſion, is of the ſame quality with the ſum of the products, and divided by the firſt diviſor, leaves the remainder proper thereto; and ſo of the other diviſors.

To

To illuſtrate this rule, take the following example;

					products.
In the year 1668	Sun's cycle,	25	the multipliers	4845	121125
	Moon's cycle,	16		4200	67200
	Indiction,	6		6916	41496

The ſum of the products is 229821, which divided by 7980, the remainder is 6381, the year of the *Julian* period, from which ſubtracting 709, there remains 5672, for the age of the world, according to archbiſhop *Uſher*.

To find the year of the *Julian* period for any year of our Lord, we muſt know the prime, cycle of the ſun, and number of the *Roman* indiction for the firſt year of the *Chriſtian Æra*, which Mr. *Street* comprehends in the following verſe,

When 1, 9, 3 to the year have added been
Divide by 19, 28, fifteen.

The remainders are the cycles and indiction of the given year of Chriſt, and thus they were found above for the year 1668.

The uſe of the prime is to find the epact, and thereby the moon's age, time of high water, *&c.* the ſolar cycle is uſeful in finding the Dominical letter, and thereby to know the day of the week, on which any day of any month falls; but this is more eaſily obtained, by finding on what day of the week the firſt of *March* happens for ever; which is thus; to the number two add the year of our Lord, and its even fourth part, neglecting the remainder, if any; then divide that ſum by 7, and the remainder, neglecting the quotient, ſhews the number of the day of the week, accounting Sunday, firſt; if 0 remains, the firſt of *March* falls on a Saturday. Thus $2+1669+417=2088$ being divided by 7, the remainder is 2, ſhewing the firſt of *March* 1669, to fall on a Monday: If it were required to do this for years preceeding our Saviour's nativity, then take this rule; to the year add its even fourth part, divide the ſum by 7, and the remainder ſhews the day of the week, accounting Sunday firſt, Saturday ſecond, and ſo backward.

To find what day of the month, in the firſt week of each month happens to be on the ſame day of the week, with the firſt of *March*; uſe the following verſes, wherein the 12 words relate to the 12 months of the year, accounting *March* the firſt.

Aſk Endleſs Comfort, God Enough Beſtows,
From Divine Axioms, Faith Confirmed Grows.

The alphabetical number of the firſt letter of the word proper to the given month, is the anſwer; *e. g.* If the month were *April*

 the

the word anſwering thereto, is endleſs, and E is the fifth letter in the alphabet: Wherefore conclude, that the firſt of *March* and the fifth of *April* do for ever happen on the ſame day of the week.

To find on what day of the week the firſt day of each month happens: Suppoſing the firſt of *March* known, it might be found out by the former problem, but the following verſe, beginning with *March* like the former, is readier for the purpoſe;

A Dreadful Fire, Beholders Daily Gaze,
Chaſtiſed *England.* Ah! Cruel Fatal Blaze.

In 1669, the firſt of *March* is *Monday*, I would know on what day of the week, the firſt of *October* happens; the word anſwering to that month, is *England*, then A *Monday*, B *Tueſday*, &c. and E *Friday*, which is the day ſought.

To find on what day of the month, the ſun enters into any ſign of the zodiack; the following verſe may ſerve for that purpoſe.

Charles Brought Content, Divers Effects Enſue,
Envy, Fear, Dolour, Danger, Bid Adieu.

Here again, the 12 words refer to the 12 months, and *March* is the firſt: To the number of the letter of the alphabet, the word begins with, add 7. *e. gr.* Fear is the word for *October*, and F the ſixth letter: Wherefore the ſun enters into the eighth ſign, *viz. Scorpio*, on the 13th of *October.*

Experiments concerning the Relation between Light *and* Air *in ſhining* Wood *and* Fiſh; *by* Mr. Boyle. Phil. Tranſ. N° 31. p. 581.

Exp. I. THE honourable Mr. *Boyle*, on putting a piece of ſhining rotten wood, of the bigneſs of a groat or leſs, into the receiver of an air pump, found that after the firſt five or ſix exſuctions, it loſt not its light; but afterwards, as the air was exhauſted, it grew more and more dim, till at laſt, about the tenth exſuction, it emitted no light at all.

Exp. II. As the external air was gradually admitted, he obſerved the ſeemingly extinguiſh'd light to revive ſo faſt, that it ſeemed like a little flaſh of lightning, and the brightneſs of the wood was greater than when firſt put into the receiver; upon including it in a very ſmall receiver of clear glaſs, he found that in this, the light would begin to grow faint, at the ſecond, or at leaſt, the third exſuction of air, and at the ſixth or ſeventh would quite diſappear.

Exp. III.

Exp. III. That he might diſcover whether this luminouſneſs of the wood, would be affected like a live coal or the life of an animal, and be quite extinguiſhed, upon excluding the air for a few minutes; he exhauſted the receiver till the light of the wood quite diſappeared, tho' the air was excluded for about a quarter of an hour; but it happening then to be too late to proſecute the experiment any further, the air was admitted, upon which, the wood recovered its light, tho' it ſeemed leſs vivid than before. The following night, a piece of wood was put in, bigger than the former, above an inch long, which ſhone very ſtrongly; and having by a few exhauſtions quite deprived it of light, it was left in the exhauſted receiver for a full half hour, but ſome air getting into the receiver ſpoiled the experiment.

Exp. IV. He obſerved, that the effect, the withdrawing of the air, has upon a body in the receiver, is more conſiderable ſome minutes after, than immediately, upon ceaſing to pump; and thus, bodies, whoſe light is not made wholly to diſappear, by continuing for ſome time longer in that ſtate, might probably loſe their remaining light; to confirm this, he put in a body that was not wood, ſome of whoſe parts were more luminous than others; and having exhauſted the air, the brighter parts ſhone but faintly, but by continuing it therein, he perceived the luminous portions to become ſtill dimmer and dimmer; but upon the admiſſion of the air, the body began to ſhine again.

Exp. V. The rarefaction of the air having ſuch an effect on ſhining wood, he would try, what the compreſſion of it would do: For which end, he included a piece of the wood in a little compreſſing inſtrument, ſuch as that deviſed by Dr. *Hook*; but tho' the air was forcibly enough impelled into the glaſs, yet by reaſon of the thickneſs required in ſuch glaſſes, and the opacity thence ariſing, he could not then determine, whether any change or not were made in the luminouſneſs of the wood.

Exp. VI. In order to try, whether a ſmall quantity of air, without renewing it, could ſuffice to maintain this light; tho' not that of a live coal, or a piece of match; he hermetically ſealed a piece of ſhining wood in a tube of clear thin glaſs; which being carefully done, the wood retained its light very well and ſhone very briſkly, and that for a conſiderable time.

Exp. VII. He put a piece of red hot iron into a receiver, and exhauſting the air ſeemed to have no effect on it to diminiſh its ſhining.

Exp. VIII. Having hermetically ſealed up a ſmall piece of ſhining wood in a ſlender tube, and putting it into a ſmall re-

ceiver, he exhaufted the air and afterwards re-admitted it; but neither way was there perceived any fenfible decrement or increafe of light, which fhows that the motion of bodies, as the corpufcles of light, may be freely made in *Vacuo* without the affiftance of a medium or vehicle.

Exp. IX. He put into a cylindrical tube, whofe bore was about half an inch, and its length a foot or more, a piece of fhining wood, wedged in with cork towards its fealed end, to keep it from falling, which he inverted into another glafs full of quickfilver, and both were put into a long receiver, and pumping a little, that the air in the tube, expanding itfelf, might deprefs the mercury, and efcape into the receiver, and then admitting the external air, that the mercury might fill the cavity of the tube, now freed from fo much of its air; after this he pumped again, and obferved, that as the air in the tube, by its fpring, expanded itfelf more and more, the fhining wood grew dimmer and dimmer, till at laft, it ceafed to fhine; but upon re-admitting the air, the quickfilver was driven up again, and the air above the mercury reftored to its fomer denfity, upon which the wood recovered alfo its light; the air, when expanded, reached to about a foot or more from the fealed end to the furface of the mercury, and when condenfed, it took up three inches only.

Exp. X. He put a fhining fifh into a receiver, whofe belly, and fome parts of the head were more luminous than the reft; and upon exhaufting the receiver, it appeared that the abfence of the air did confiderably leffen, and in fome places eclipfe the light of the parts that fhone lefs; but the belly appeared as luminous as before; and upon admitting the air, the light feemed to revive and encreafe.

Exp. XI. He put into a receiver fmall pieces of rotten fifh, and excluded the air for 24 hours, but upon its admiffion, the fifh regained its light.

Exp. XII. He put a piece of fhining fifh into a wide-mouthed glafs half full of fair water, and placing it in a receiver, he exhaufted the air; and he found that neither the abfence nor the admiffion of the air had any great effect on the light of the immerfed body.

All thefe experiments were made with whitings, which are the fitteft of any for fuch trials.

Exp. XIII. Upon including a piece of fhining fifh into an exhaufted receiver, for 48 hours, in which time its light vanifhed, but on the ingrefs of the air, it recovered its fhining again. This fuddennefs, with which thefe bodies were re-kindled, upon the

the firſt contact of the air revived ſome ſuſpicions in him, about the poſſible cauſes of theſe ſhort-lived apparitions of light, which diſcover themſelves upon men's coming in, and conſequently admitting freſh air into vaults, that had been long ſhut up.

A Compariſon between live Coals *and ſhining* Wood; *by the Same.* Phil. Tranſ. N° 32. p. 605.

BOTH live coals and ſhining wood emit a native light, and not an adventitious one, for they ſhine the more vividly, the darker the place is made: They both require the preſence of the air, and that of a particular denſity; ſhining wood and a live coal, being deprived for a time of their light, by excluding the contiguous air, preſently recover it on the admiſſion of freſh air; they are both eaſily extinguiſhed by water and many other liquors; this is plain as to coals; and upon wetting a piece of ſhining wood with a little common water in a clear glaſs, it preſently loſt all its light; the event was the ſame, by trying ſtrong ſpirit of ſalt, weak ſpirit of ſal-armoniac, as alſo high rectified ſpirit of wine, and rectified oil of turpentine; as a live coal is not extinguiſhed by the coldneſs of the air, ſo neither is a piece of ſhining wood.

A live coal and ſhining wood differ in this, that whereas the light of the former is readily extinguiſhable by compreſſion, the latter is no ways affected by it; a live coal will in a few minutes be totally extinguiſhed by excluding the air, whereas ſhining wood, will immediately recover its light on the admiſſion of it, even tho' excluded for half an hour; they differ alſo in this, that a live coal being put into a ſmall cloſe glaſs, dies in a few minutes; but a piece of ſhining wood will continue to ſhine for whole days: A coal, as it burns, emits a great deal of ſmoke, which ſhining wood does not; a coal in ſhining waſtes, which the latter does not; a live coal is actually hot, whereas ſhining wood is not ſo much as lukewarm.

A Blemiſh *in a Horſe's Eye*; *by Dr.* Lower. Phil. Tranſ. N° 32. p. 613.

THE eyes of horſes are affected with a peculiar blemiſh, which is uncommon to other animals, and not taken notice of by any author; it is a ſpungy excreſcence, commonly of a dark muſk-colour, growing out of the edge of that coat of the eye, called the *Uvea*, which depraves the ſight, or totally deſtroys it: To conceive the manner how it is done, it muſt be obſerved, that the *Uvea* is a muſcular coat, contracting and dilating itſelf,

for

for the admiſſion of ſo much light, as the eye can bear; ſo that the brighter the light is, the greater the contraction, and the darker the place, the greater the dilatation, as may be plainly ſeen in a cat's eye; if that ſpungy ſubſtance be ſo large, or in number ſo many, as to grow in ſeveral places about the *Pupilla* or ſight of the eye, where it contracts itſelf, the ſight is very much, or totally obſtructed, and conſequently the horſe ſees little or nothing at all; as the doctor obſerved in ſome horſes, which being brought out into ſun-ſhine, could not ſee at all, and would ſuffer their pupil to be touched without winking; but the ſame horſes, being led back again to the ſtable, the *Uvea* in that dark place dilating itſelf, they could ſee very well again, and would not ſuffer his finger near their eye, without winking and toſſing their heads; and he was told that they were apt to ſtumble in the day-time, if it happened to be bright and ſun-ſhiny, but would travel well and ſecurely in the evening, and in dark cloudy weather. The doctor thinks that this diſorder proceeds not from ſtraining in great draughts or races, &c. becauſe he has obſerved theſe excreſcences in young horſes, of three or four years old; which, after they have been taken up from graſs, and kept with dry meat, have very much abated; but upon being turned out again to graſs in the ſpring, grew to the uſual bigneſs: And whether they proceeded from their moiſt feeding, or holding down their heads, whereby a great flux of humours was derived to that part, he could not determine. The larger and more numerous theſe excreſcences are, the more the ſight of the eye is in danger of being obſtructed; the excreſcences, on the upper edge of the *Uvea*, are apt to grow the largeſt, and hinder the ſight moſt; thoſe on the middle of the *Uvea*, do more obſtruct the ſight, by diſtracting the object, then thoſe on either corner of it: The cure can only be expected from a drying kind of diet; tho' ſomething may be deviſed to ſhade the eyes externally, and keep them from being expoſed to the ſun, whereby the pupil will not be ſo cloſely contracted, nor conſequently the ſight ſo much obſtructed.

Of Spots *in* Venus; *by* S. Caſſini. Phil. Tranſ. N° 32. p. 615.

S. *Caſſini* diſcovered, *Octob.* 14th, 1666, 5 h. 45′. *p. m.* very near the centre of *Venus*, on the northſide, a part brighter than the reſt; and he obſerved at the ſame time, weſtward, two obſcure ſpots, ſomewhat oblong; which parts he could not well ſee again till *April* 28th, 1667, when, about a quarter of an hour before ſun-riſing, he ſaw a bright part, ſituated near the

the ſection, and diſtant from the ſouthern horn, a little more than $\frac{1}{4}$ of its diameter; and near the eaſtern ring he ſaw a dark and ſomewhat oblong ſpot, which was nearer the northern than the ſouthern horn; at ſun-riſing he perceived, that this bright part was diſtant from the ſouthern horn, $\frac{1}{3}$ of its diameter; and he was ſurpriſed to find, that the ſame motion, which was made from ſouth to north in the inferior part of the diſk, was on the contrary made from north to ſouth in the ſuperior part; the next day, at ſun-riſing, that bright part was not far from the ſection, being diſtant from the ſouthern horn $\frac{1}{4}$ of the diameter: When the ſun was 4° high, the ſame was ſituated near the ſection, and remote from the ſouthern horn $\frac{2}{7}$ of the diameter; the ſun being elevated 6°. 10′. it ſeemed to have paſſed the center, and to have been interſected by the ſection of the diſk; the ſun being 7° high, it appeared more northerly, together with two obſcure ſpots, ſituated between the ſection and circumference, and equally diſtant from each other, and from each horn, on both ſides: And the ſky being very clear, he obſerved the motion of the bright part for 1 $\frac{1}{2}$ hour; which then ſeemed to be made exactly from ſouth to north, without any ſenſible inclination either eaſt or weſtward: *May* 10th and 13th before ſun-riſing, he obſerved ſtill the bright part near the center northward: *June* 5th and 6th, before ſun-riſing, he obſerved the ſame between the northern horn and the center of the planet, and he remarked the ſame irregular variation in the obſcure ſpots. Theſe appearances in *Venus*, were ſeen for ſo ſhort a time, that it is difficult to know when they return to the ſame place; yet this he aſſured, ſuppoſing that this bright part of *Venus* has always been the ſame, that it compleats its motion either of revolution or libration in leſs time than a day, ſo as to return in about 23 hours to the ſame ſituation in this planet, but yet with ſome irregularity.

The Cure of an inveterate Phrenſy, *by Transfuſion; by M.* Denis. Phil. Tranſ. N° 32. p. 617.

THE patient is about 34 years of age: His phrenſy was thought to be owing to a diſappointment in love; his firſt fit was very violent, and laſted ten months without any interval; afterwards he recovered, and married; but in a year's time he relapſed again, his madneſs continuing upon him for nine or ten months without any reſpite; and thus he relapſed, and was cured ſeveral times in the compaſs of 7 or 8 years.

Dec.

Dec. 19th, 1667, M. *Emmerez* opened the crural artery of a calf, and after the neceſſary preparations, and drawing about ten ounces of blood of the right arm of the patient, he transfuſed into him about five or ſix ounces from a calf; next morning he ſeemed to be a little ſober, and after taking from him two or three ounces of blood, there was a ſecond transfuſion, more plentiful than the firſt, made into his left arm, the patient being thought to have then received more than a whole pound; as the blood began to enter into his veins, he felt a heat along his arm and under his arm-pit, as in the firſt transfuſion; his pulſe roſe, and a plentiful ſweat came over all his face; he complained of great pains in his kidneys, and that he was ſick at his ſtomach, and ready to choak, unleſs ſet at liberty; upon which the pipe that conveyed the blood was taken out of his arm, and whilſt the wound was cloſing, he vomited a great deal of bacon and fat, he had eaten half an hour before; he had an inclination to make urine, and to go to ſtool; being put to bed, he fell a-ſleep about ten o'clock at night, and waked not till about eight next morning; at which time he ſhewed a ſurprizing calmneſs, and great preſence of mind, in expreſſing all his pains, and a general laſſitude he felt all over his limbs; he made a great glaſs full of urine, as black, as if it had been mixed with ſoot; next day he filled another urinal with his water, almoſt as black as that of the preceeding day; he bled at the noſe very plentifully, upon which it was thought proper to take two or three porringers of blood from him; next day his urine began to clear up, and afterwards by little and little recovered its natural colour: There was a third transfuſion deſigned, but obſerving ſo great an amendment in his carriage, that reſolution was quite laid aſide; he is at preſent of a very calm ſpirit, performs all his functions very well, and ſleeps ſound, only now and then complains of troubleſome dreams.

An Hermaphrodite; *by Dr.* Tho. Allen. Phil. Tranſ. N° 32. p. 624.

AMIDST the various and uncommon *luſus*, or rather errors of nature, there is no inſtance more extraordinary than the preſent; this hermaphrodite is not to be reckoned either among thoſe obſcene women, called by the *Greeks Tribades*, and who were frequently to be met with in *Egypt*, or to be equalled by any deſcription yet extant: The name of the perſon is *Ann Wild*, born *Feb.* 2d, 1647, at *Ringwood* in *Hamp-*

Hampshire: At six years of age playing and wrestling with her fellow children, there appeared two tumors like *Hernias* or ruptures; in reducing which, all the care of surgeons was ineffectual; for they proved to be testicles, which now grown big, and included in a *Scrotum*, seemed to differ in nothing more from those of a man, than that each testicle had its own peculiar and distinct *Scrotum*, but in such a manner that the production of both formed the *Labia* of the *Vulva*; in the *Sinus* or *Fissura magna*, the *Nymphæ* and *Carunculæ Myrtiformes* appeared entire; and half the *Vulva* was covered with a thin membrane from the *Perinæum*, and there was no appearance of a *Clitoris*; the *Uterus*, and its neck were exactly like those of a female; she passed for a woman till the thirteenth year of her age, was clad as such, and performed all the duties of that sex; till once happening to be kneading dough, all of a sudden, a *Penis*, which till then lay concealed, broke forth, to the great surprize of the patient; in an erection it was about four inches long, and its situation was the same with the *Penis* of a man, furnished likewise with a *Glans*, and a *Præputium* fastened to the *Frænum*, in the same manner as in the male; but the *Glans* being imperforated, tho' it seemed to be covered only with a thin membrane, that might be easily perforated, denied egress to the *Semen*, wherefore it made its way thro' the *Pudendum Muliebre*, possibly in a refluent manner: At sixteen years of age, her *Menses* began to flow periodically and regularly, and continued so for two years, at the end of which, they ceased, and she began to have a beard, and all her body was covered with hair; her voice, habit of body, and hair of her head resembled those of a man, the breasts and nipples were small, the *Thorax* broad, the *Ischia* were at no great distance from each other, and the *Nates* were smaller than those of women; she had the passions of both sexes; at the sight of a woman her *Penis* was erected, and at the sight of a man it became flaccid: It may not be improper to subjoin this one circumstance, that as one night she was making merry with her companions, she cast her eyes upon a handsome man, and became so much in love with him, that the excess of her passion made her hysteric, which appeared not only from the symptoms, such as a swelling of the *Abdomen*, singing, laughing, and crying, but also from the cure, which was effected by an application of a plaister of *Galbanum* to the region of the navel, and by exhibiting hysteric remedies.

Grinding Optic *and* Burning Glaſſes *of other Figures than Spherical*; *by Mr.* Smethwick. Phil. Tranſ. N° 33. p. 631.

MR. *Smethwick* produced ſpecimens of his invention in a teleſcope, a reading, and two burning glâſſes, before the Royal Society, *Feb.* 27th, 166$\frac{7}{8}$: The teleſcope was about four foot long, with four glaſſes, the three eye-glaſſes, being plano-convex, were of this new figure, and the fourth a ſpherical object glaſs; upon comparing this with a common, yet very good teleſcope, longer by about four inches, it was found to exceed the other in goodneſs, by taking in a greater angle, and repreſenting the objects more exactly in their reſpective proportions, and bearing a greater aperture: The reading glaſs of the ſame figure, being compared with a common ſpherical glaſs, far excelled it, by greatly magnifying and ſhewing diſtinctly the letters, but this it could do on one ſide only, ſpherical glaſſes anſwering equally on both ſides: Of the two burning concaves, one was of ſix inches diameter, and its focus three inches diſtant from the center; the other was of the ſame diameter, but leſs concave, and its focus ten inches diſtant; when they were brought near a large lighted candle, they warmed a little the faces of thoſe, that were four or five foot diſtant; and when held to the fire, burned gloves and cloaths at the diſtance of three foot. In the preſence of Dr. *Ward*, biſhop of *Sarum*, the deeper of the two concaves turned wood into flame in 10 ſeconds, and the ſhallower in 5, and that in autumn, about 9 o'clock in the morning, in gloomy weather; the deeper concave, when held to a lucid body, would caſt a ſtrong light, ſufficient to read by at a conſiderable diſtance; by expoſing the ſame to a northern window, on which the ſun ſhined not at all, or very little, it would warm one's hand, but this it would not do after ſun-ſet.

Tides *obſerved at* Plymouth; *by Mr.* Colepreſs. Phil. Tranſ. N° 33. p. 632.

THE diurnal tides, from about the latter end of *March*, till the latter end of *September*, are about a foot higher in the evening than in the morning, that is, in every tide that happens after noon and before midnight; on the contrary, the morning tides from *Michaelmaſs* to *Lady-day*, are conſtantly higher by about a foot, than thoſe in the evening: And this proportion holds in both, in the intermediate times of increaſe and decreaſe: The higheſt monthly ſpring-tide is always the third

third after new or full moon; if a cross wind intercept not the course of the water, as a north-east or north-west: The highest spring-tides make the lowest ebbs: The velocity of the water increases till half-flood, when it is greatest, and decreases proportionably till high-water; as appears from the following scheme, collected from observations made at several times and places, which tho' calculated for *Plymouth* haven, where the water usually rises about sixteen foot, yet it may serve indifferently for other places by a proportional addition or subtraction.

	Time.	Height.			Time.	Height.	
	h.	f.	inch.		h.	f.	inch.
Flowing	1	1	6	Ebbing	1	1	6
	2	2	6		2	2	6
	3	4	0		3	4	0
	4	4	0		4	4	0
	5	2	6		5	2	6
	6	1	6		6	1	6

The usual number of tides from one new moon to the next, or from one full moon to the succeeding, is fifty-nine.

The squaring the Hyperbola; *by the Lord Viscount* Brounker. Phil. Transf. N° 34. p. 645.

LET AB, Fig. 6. Plate IV. be one assymptote of the hyperbola E d C, and let AE and BC be parallel to the other; and let AE be to BC as 2 to 1, and let the parallelogram ABDE be equal to 1; and supposing that EA, $\alpha\zeta$, KH, Bη, dθ, $\gamma\kappa$, $\delta\lambda$, $\varepsilon\mu$, CB, &c. are in an harmonic series, as is demonstrated by Dr. *Wallis*, *Prop.* 87, 88, &c. *Arith. infinitor.*

$$\text{Then } ABCdEA = \frac{1}{1\times2} + \frac{1}{3\times4} + \frac{1}{5\times6} + \frac{1}{7\times8}, \text{ \&c.}$$

$$EdCDE = \frac{1}{2\times3} + \frac{1}{4\times5} + \frac{1}{6\times7} + \frac{1}{8\times9}, \text{ \&c.}$$

$$EdC\gamma E = \frac{1}{2\times3\times4} + \frac{1}{4\times5\times6} + \frac{1}{6\times7\times8}, \text{ \&c.}$$

For in Fig. 7, 7. the Parallelogram

$$CA = \frac{1}{1\times2}$$

$$dD = \frac{1}{2\times3} \quad dF = \frac{1}{3\times4}$$

And in Fig. 8. the Triangles

$$EdC = \frac{1}{2\times3\times4} = \frac{\square dD - \square dF}{2}$$

$$Ebd = \frac{1}{4\times5\times6} = \frac{\square br - \square bn}{2}$$

$br = \frac{1}{4\times5}$	$bn = \frac{1}{5\times6}$	$dfC = \frac{1}{6\times7\times8} = \frac{\square fG - \square fk}{2}$
$fG = \frac{1}{6\times7}$	$fk = \frac{1}{7\times8}$	$Eab = \frac{1}{8\times9\times10} = \frac{\square aq - \square ap}{2}$
$aq = \frac{1}{8\times9}$	$ap = \frac{1}{9\times10}$	$bcd = \frac{1}{10\times11\times12} = \frac{\square cs - \square cm}{2}$
$cs = \frac{1}{10\times11}$	$cm = \frac{1}{11\times12}$	$def = \frac{1}{12\times13\times14} = \frac{\square et - \square el}{2}$
$et = \frac{1}{12\times13}$	$el = \frac{1}{13\times14}$	$fgC = \frac{1}{14\times15\times16} = \frac{\square gu - \square gh}{2}$
$gu = \frac{1}{14\times15}$	$gh = \frac{1}{15\times16}$	&c.
&c.	&c.	

Note, $\frac{1}{2}CA = dD + dF$, $\frac{1}{2}dD = br + bn$, $\frac{1}{2}dF = fG + fk$, $\frac{1}{2}br = aq + ap$, $\frac{1}{2}bn = cs + cm$, $\frac{1}{2}fG = et + el$, $\frac{1}{2}fk = gu + gh$, &c. Therefore, in the first series, half the first term is greater than the sum of the two next, and half this sum of the second and third greater than the sum of the four next; and half the sum of these four greater than the sum of the next eight, &c. in *infinitum*. For, $\frac{1}{2}dD = br + bn$, but $bn > fG$, therefore $\frac{1}{2}dD > br + fG$, &c. And in the second series, half the second term is less than the sum of the two next, and half this sum, less than the sum of the four next, &c. in *infinitum*. The first series are the even terms, *viz.* the 2d, 4th, 6th, 8th, 10th, &c. And the second, the odd, *viz.* the 1st, 3d, 5th, 7th, 9th, &c. of the following series, *viz.* $\frac{1}{1\times2}$, $\frac{1}{2\times3}$, $\frac{1}{3\times4}$, $\frac{1}{4\times5}$, $\frac{1}{5\times6}$, $\frac{1}{6\times7}$, &c. *in infinitum* $= 1$: Putting a for the number of terms taken at pleasure, $\frac{1}{a^2+a}$ is the last, $\frac{a}{a+1}$ is the sum of all these terms from the beginning, and $\frac{1}{a+1}$ the sum of the rest to the end. That $\frac{1}{4}$ of the first term in the third series is less than the sum of the two next, and $\frac{1}{4}$ of this sum less than the sum of the four next, and $\frac{1}{4}$ of this last sum less than the next eight, is thus demonstrated: Let a be equal to the third or last number of any term of the first column, *viz.* of divisors.

$$\frac{1}{a\times a-1\times a-2} = \frac{1}{a^3-3a^2+2a} = \frac{16a^3-48a^2}{16a^6-96a^5+232a^4 +56a-24}$$

$$\frac{+56a-24}{-288a^3+184a^2-48a}=A$$

$$\left.\begin{array}{l}\dfrac{1}{2a\times 2a-1\times 2a-2}=\dfrac{1}{8a^3-12a^2+4a}\\[2ex] \dfrac{1}{2a-2\times 2a-3\times 2a-4}=\dfrac{1}{8a^3-36a^2\times 52a-24}\end{array}\right\}=\frac{16a^3-48a^2}{64a^6-384a^5}$$

$$\frac{+56a-24}{+880a^4-960a^3+496a^2-96a}=B$$

$$\frac{64a^6-384a^5+928a^4-1152a^3+736a^2-192a}{64a^6-384a^5+880a^4-960a^3+496a^2-96a}\times\tfrac{1}{4}A=B.$$

And $48a^4-192a^3+240a^2-96a=$ excess of the numerator above the denominator. But the affirmative $>$ the negative, *i. e.* $48a^4-192a^3+240a-96a$ or $a^3+5a>4a^2+2$, if $a>2$ therefore $B>\frac{1}{4}A$.

Therefore $\frac{1}{4}$ of any number of A, or terms, is less than their so many respective B; *i. e.* than twice so many of the next terms, Q. E. D.

By any one of these three series, it is easy to calculate, as near as you please, these and the like hyperbolic spaces, whatever be the rational ratio of A E to B C.

The Variety of the annual Tides *in several Places of* England; *by Dr.* Wallis. Phil. Transf. N° 34. p. 652.

DR. *Wallis*, in his hypothesis of the tides, made the annual high-tides happen about the beginning of *November* and *February*, particularly, for the coast of *Kent*, and consequently, the river *Thames* and *Medway*: But the annual high-tides in the *Severn* and at *Cheapstow Bridge* are said to be about the beginning of *March*, and the end of *September*; which tho' they agree not with the particular times on the coast of *Kent*, yet they agree thus far, that the former precedes one equinox, as much as the latter follows the other equinox; the high-tides about *Plymouth* happen about the 22d of *February*, later than that on the coast of *Kent*, but sooner than that on the *Severn*: The reasons of all these varieties are to be accounted for from the particular position of those parts, and in brief may be these; the general hypothesis of the earth's diurnal motion from west to east would throw the waters not following so fast, from east to west, which causes the constant current within the *Tropics*, where the circles are greatest, from the coast of *Africa*, westward to that of *America*; and this is also the reason of the constant easterly breeze in those parts: But the sea beating on the coast of *America*, is reflected with an eddy on either hand, and consequently returns from the *Ameri-*

can

can ſhore towards the coaſt of *Europe*; where the parallels being leſs, and conſequently the diurnal motion ſlower, does not throw the waters ſo ſtrongly weſtward as between the *Tropics*, and ſo not ſtrong enough to overcome the eddy, whereby the ſea has a north-eaſterly motion; the current therefore of our ſeas being to the north-eaſt, we are next to conſider, at what times it runs more to the north, and when more to the eaſt: When it runs moſt northerly, it runs up the *Iriſh* ſea and ſo up the *Severn*: When moſt eaſterly, it runs ſtreight up the channel, and ſo to the coaſt of *Kent*; when between theſe points, it ſtrikes againſt *Devonſhire*, *Cornwall*, &c. The annual motion of the earth in the zodiac, and the diurnal in the equator, are not preciſely in the ſame direction, but make an angle of $23\frac{1}{2}°$ at the equinoxes; and running, as it were parallel, at the ſolſtices; and in proportion to their diſtance from theſe points, ſo is the inclination varied: And theſe ſeveral directions of motion do more or leſs vary the compound motion of both from the eaſt and weſt, according as the ſun is farther from or nearer to the ſolſtices: And conſequently, this inclination throws the conſtant current of our ſeas more to the north and ſouth, nearer the equinoxes; and more to the eaſt and weſt, further from them; which is the reaſon, why the current up the *Iriſh* ſea is, nearer to the equinoxes, at the beginning of *March* and end of *September*, and up the channel or narrow ſeas, farther from them, at the beginning of *February* and *November*, and in the intermediate times on the coaſt of *Devonſhire* and thereabouts.

Tides *obſerved at* London; *by Mr.* Hen. Philips. Phil. Tranſ. N° 34. p. 656.

ACcording to Mr. *Philips* the true time of the tides is very inaccurately calculated by moſt ſeamen and aſtronomers, as if, when the moon is on a particular point of the compaſs, or ſo many hours paſt the meridian, it were high-water in ſuch and ſuch a port at all times of the moon; and thus they compute the tides to differ every day 48 m. *e. gr.* a ſouth-weſt moon makes full tide at *London*, that is, it is high-water there when the moon is three hours paſt the meridian: It is true, this holds at new and full moon, but not at other times of the moon. Mr. *Philips* found the tides happen at *London*, an hour and a half ſooner in the quarters, than in the new and full moon, and the true times of the tides to be decreaſing from the new and full moon to the quarters, but not equally; there being ſome little difference of alteration, both at the new and full moons, as alſo at the quarters; and the greateſt difference was in the intermediate times between

between them, anſwering to a circular proportion in this manner. Divide a circle into 12 equal parts or hours (ſee fig. 9. Plate IV.) according to the moon's motion or diſtance from the ſun, from new to full moon. Let the diameter of the circle be divided into 90 parts or minutes, that is, according to the time of the difference of tides, between the new or full moon, and the quarters, which is an hour and a half; croſs the diameter from hour to hour with perpendicular lines; reckon the time of the moon's coming to the ſouth in the circumference of the circle, and obſerve the perpendicular falling from that point upon the diameter; the proportional minutes cut thereby will ſhow how many hours or minutes are to be ſubſtracted from the time of high-tides at new and full moon, to have the true time for that day: *e. gr.* At *London*, on new and full, it is high-water at three o'clock; that is, when the moon is three hours paſt the meridian, and ſo by the common rule, when the moon is about four days old, it will be ſouth about three, and high-water three hours after that; that is, at ſix o'clock; but by Mr. *Philip*'s rule, if you compute the time of the moon's ſouthing in the circumference, the perpendicular line from three to nine, cuts the diameter in the middle, at 45 m. which ſhews, that ſo much is to be deducted from the time of high-tides at new and full moons; ſo that it is high-water 45 m. before *6*, that is, at 5 hours 15 m. and not at *6*, according to the common rule. The ſame thing may be done for any other port or place, if you know the time of high-water at new and full moon there; and that the more readily, if you ſet down the time of high-water at new and full moon under the diameter, as in the figure is done for *London*, where it is high-tide at 3 o'clock, ſo that, when the moon is ſouth at 3, the perpendicular interſects the diameter at 2 hours 15 m. and ſo when the moon is ſouth at 9, by adding 2 hours 15 m. you have the time of high-water, which is 11 hours and 15 m. and thus you may eaſily make a table, which, by the moon's ſouthing, will readily ſhew the time of high-water at any age of the moon: But if the difference between the neap and ſpring-tides be not ſo great as the difference at *London*, the diameter muſt be divided into fewer parts.

Of the Poiſon of the Tarantula; *by* J. W. Sengwerdius. Phil. Tranſ. N° 34. p. *660*.

THE poiſon of the *Tarantula*, being viſcous or clammy, does not exert itſelf immediately; for the firſt two years it only cauſes various diſeaſes in the patient, as dejection of appetite, burning fevers and cachexies, after which, ſome are ſeized with fits of ſinging and laughing, others weep and cry, others

ſleep,

ſleep, in ſome continual watching is obſerved, in ſome, vomiting, in ſome, dancing and ſweating, in ſome, madneſs; others again fancy themſelves kings, and others, ſlaves; but all of them without diſtinction delight in muſick, and by it they are moved either to dancing or geſticulations, which proves their only cure; but every *Tarantatus* or patient in this diſeaſe has his peculiar and ſpecifick tune; for that which is unſuitable gives great uneaſineſs to the patient: The *Tarantati* are likewiſe delighted with different colours, ſome with yellow, ſome with green, and ſome with red. Some *Tarantula*'s are ſaid to have contrary poiſons, ſo that if the ſame perſon be bitten by both, he cannot be made to dance, becauſe theſe different poiſons require different tunes and inſtruments: It is alſo obſerved that the tune that is agreeable to the patient, is ſo likewiſe to the *Tarantula* itſelf, and on the contrary; it is alſo found, that not only men, but other animals, as cocks, waſps, &c. bitten by theſe ſpiders, dance.

An experiment concerning Deafneſs; *by Dr.* W. Holder. Phil Tranſ. N° 35. p. 665.

A Young gentleman was born deaf, and continued dumb till 10 or 11 years of age; his mother, when big with him, received a ſudden fright, by which, the child's head and face were a little diſtorted, his whole right ſide being ſomewhat elevated, and the left depreſſed, ſo that the paſſage of the left ear was quite ſhut up, and that of the right proportionably diſtended, and too open; his auditory nerve ſeemed to be entire, for he could hear the ſound of a lute ſtring, by holding one end thereof in his teeth, as likewiſe any great ſound; whence the defect was ſuppoſed to conſiſt in the want of a due tenſion in the membrane of the drum of the right ear; for the laxneſs of that will deaden and damp the ſound; and becauſe it is fixed in a bony ring, and not capable of tenſion like a drum, there remains only the drawing it into a conoid form at the centre; and that is the principal office of the three little bones, *viz.* the *Malleus*, *Incus* and *Stapes*; and by a muſcle inſerted into the *Incus*, theſe three bones, which otherwiſe would lie in a ſtraight line, are brought to an arched poſition, and thus the membrane of the drum from a plain figure is changed into a conoid, and conſequently becomes tenſe: And for experiment, a temporary cure was deviſed, which was a drum beaten near him, whoſe ſound, during its continuance, muſt needs give the membrane of the *Tympanum* a tenſion, by driving, and ſwelling it inwardly; and it ſucceeded to expectation; for while the drum was a beating, he could hear thoſe who ſtood behind him, calling him ſoftly by his

his name, which he underſtood, having learned to ſpeak and pronounce it among other words; but when the drum ceaſed, he could not hear, tho' called upon very loud.

Another gentleman of *Oxfordſhire*, who was deaf to a very great degree, never heard ſo well and eaſily, as when he was diſcourſing with company in a coach, that went faſt and made a rumbling noiſe.

A new Diſcovery touching Viſion; *by M.* Mariotte. Phil. Tranſ. N° 35. p. 668.

M. *Mariotte* obſerved in ſeveral diſſections of men as well as brutes, that the optic nerve never anſwers exactly to the middle of the bottom of the eye, that is, to the place where the picture of objects is made; but that, in man its inſertion is ſomewhat higher, and lateral towards the noſe: In order therefore to make the rays of an object fall upon the optic nerve of his eye, he made the following experiment; he faſtened a ſmall round paper, about the height of his eye, on an obſcure wall, to ſerve for a fixt point of viſion; and he fixed another on the ſide thereof, towards his right hand, at about the diſtance of two foot, but a little lower than the firſt, that it might ſtrike the optic nerve of his right eye, while he kept his left ſhut: Then he placed himſelf over againſt the firſt paper, and retired gradually, keeping his right eye fixt and very ſteady upon it; and at the diſtance of 10 foot, the ſecond paper quite diſappeared: This experiment was often repeated, varying it by different diſtances, and removing further or bringing the papers nearer to each other; he alſo tried it with his left eye, keeping his right ſhut, after faſtening the ſecond paper on the left ſide; ſo that from the ſite of the parts of the eye, it appears that this deficiency of viſion is upon the optic nerve. This experiment ſuggeſted a doubt to M. *Mariotte*, whether viſion was really performed in the *retina*, according to the common opinion, or rather in the *choroides*; for if viſion were performed in the *retina*, it ſeems that then it ſhould be made, wherever that coat is; and ſince the ſame covers the whole nerve, as well as the reſt of the bottom of the eye, there appears no reaſon why there ſhould be no viſion in the place of the optic nerve: On the contrary, if it is made in the *choroides*, it ſeems evident, that the reaſon why there is none on the optic nerve is, becauſe that coat covers not the middle of the nerve, as it does the reſt of the bottom of the eye.

In anſwer to this hypotheſis of M. *Mariotte* in relation to the place of viſion in the eye, M. *Pecquet* obſerved that he could not

fee the force of the confequence, the former would draw from the above experiment, to engage him to give up the plea for the *retina*, as the principal organ of vifion; and therefore, he obferves, that at the infertion of the optic nerve, the veffels of the *retina* are large enough to hinder vifion; and thefe veffels being branches of the veins and arteries, are derived from the heart, which, having no communication with the brain, cannot convey thither the fpecies of the objects; if therefore, the vifual rays from an object fall on the main trunks of thefe veffels, it is evident that that impreffion will produce no vifion, and that the picture of the object will be deficient, but this is not the cafe, with refpect to the fmall ramifications of thefe trunks, which are fpread upon the *retina*, for, on account of their fmallnefs, they are too inconfiderable to affect vifion.

M. *Pecquet* further adds, that the paper, the fight of which is loft, muft be at a greater or lefs diftance, according to the different make of the eyes; for fome lofe fight of it, at the diftance of two foot, fome at a lefs and others at a greater diftance; fome, a little higher, others a little lower, according to the fituation of the trunks of the veffels in refpect of the optic nerves; and fome lofe more of it than others, as thefe veffels are bigger or fmaller; and there is reafon to think that this deprivation of fight extends to the *choroides*; for the trunks of the veffels are large and long enough to reach to it, and in that cafe, it will be true, that vifion is not made in all the parts of the *choroides*; fo that this argument will equally hold againft that coat being the organ of vifion as againft the *retina*.

M. *Picard* has devifed a way, whereby an object is loft, with both eyes open, by making the image fall on both the optic nerves at one and the fame time, after this manner; faften againft a wall a round white paper, of the bignefs of an inch or two; and at the diftance of two foot, on the right and left fide of the paper, put two marks; then place yourfelf directly oppofite to the paper, at the diftance of about nine foot, and put the extremity of your finger, in fuch a manner, before both your eyes, that the right eye may not fee the left mark, nor the left eye the right mark; if you remain firm in that pofture, and look fteadily with both eyes on the extremity of your finger, the paper will quite difappear; which muft be the more furprifing, becaufe, that without this particular encounter of the optic nerves, where no vifion is made, the paper would appear double, as you will find as often as the finger is not placed as it ought to be, or when the fight is made laterally. This experiment amounts to much

the ſame with M. *Mariotte*'s; for when one looks ſteadily with both eyes on the end of one's finger, held before the marks, it is the ſame thing, as if each eye were ſingly directed, in order to loſe ſight of the paper.

Of a Controverſy between Stephano *de* Angelis *and* Riccioli *concerning the Motion of the* Earth. Phil. Tranſ. N° 36. p. 693.

Riccioli in his *Almageſtum novum* pretends to have found out ſeveral new demonſtrative arguments againſt the motion of the earth; which *Stephano de Angeli* undertakes to refute, and *Manfredi* to defend.

Riccioli's firſt argument is as follows; if the earth revolved about its axis, heavy bodies falling in the plane of the equator would not deſcend to the earth, with a real and obſervable increment of velocity, but with an apparent one, and to confirm this, he pretends, that a heavy body let fall from the top of a tower C in the plane of the equator, F. 10. Pl. IV. would by its natural motion deſcribe a portion of the line CTI which to ſenſe would be circular; this *Angeli* denies, ſhowing by computation, that *Riccioli*'s obſervation proves no ſuch thing; for according to *Riccioli*, a heavy body deſcends 15 foot in a ſecond, in 2 ſeconds 60 foot, in 3 ſeconds, 135; and ſo on, the ſpaces, from the beginning of the fall, are as the ſquares of the times; and *Riccioli* makes A B, the ſemi-diameter of the earth, 25870000 feet, and B C, the height of the tower of the *Aſinelli* in *Bononia*, 240 feet; and therefore A C is 25870240, which has the ſame proportion to F S, 15 feet, *viz.* the fall in a ſecond, which A C in parts 20000000000 has to F S $11596 \frac{54356}{224189}$; but ſuppoſing, with *Riccioli*, C S I A a ſemi-circle, F S is 53 parts, of which A C is 10000000000: Hence *Angeli* concludes, that C S I A is no ways a ſemi-circle; which is moſt certain, if the heavy body fall not to the center of the earth preciſely in 6 hours: For, in this caſe of *Riccioli*, the heavy body falls to the centre of the earth in 21 minutes and 53 ſeconds. *Manfredi*, in his anſwer for *Riccioli*, affirms, that *Angeli* underſtands not the *rule of three*, in making F S, $11596 \frac{54356}{224189}$; and *Angeli* replies, that his analogy is very clear, referring it to the determination of geometers. *Angelis* might have anſwered *Riccioli*'s argument, thus; granting the body to move equally in a ſemi-circle, for in that caſe, no heavy body would deſcend with a ſenſible increaſed velocity; but the fall of bodies is not calculated in that manner; for this

equal

equal motion in the circumference of the ſemi-circle CIA, is compounded of the equal motion in the quadrant CD, and the accelerated motion in the variable ſemidiameter CA, this accelerated motion in the ſemidiameter is the true deſcending motion; in which ſenſe *Riccioli*'s argument is very falſe. The ſecond argument is, that ſuppoſing the earth to have either a diurnal or annual motion, the ſtroke of a bullet ſhot north or ſouth would be weaker than from weſt to eaſt; *Angeli* anſwers, that the cannon-ball going from weſt to eaſt has two impulſes, one from the earth, and another from the fire; but the impulſe from the earth is common alſo to the mark, and therefore the ball ſtrikes the mark with the impulſe only received from the fire, as it does, when ſhot to the north or ſouth. The third argument is, if the earth had a diurnal revolution, a ball of clay of 8 ounces falling from a height of 240 feet, would deſcend obliquely without any real and phyſical increaſe of velocity, or at leaſt, not ſuch as would be proportional to its ſtroke and ſound; *Riccioli* ſuppoſes the curve, in which the heavy body deſcends, to be compoſed of many ſmall right lines, and proves the motion almoſt always equal in theſe lines; but *Anglics* anſwers, that the equality of motion is not ſufficient to prove the equality of percuſſion and ſound, but that there muſt be equal angles of incidence; which, in this caſe, he proves to be very unequal; and in his anſwer to *Manfredi*, he mentions an experiment made with great circumſpection by *Des Cartes* to prove the earth's motion, which was, to erect a cannon perpendicular to the horizon, and diſcharging it 24 times in that poſition, the ball fell 22 times towards the weſt, and only twice to the eaſt.

A Continuation of the Voyage to Jamaica; *by Dr.* Stubbes. Phil. Tranſ. N° 36. p. 699.

ALL the alterations the ſweet-meats, lozenges, and gammons of bacon underwent, muſt be owing to ſome peculiar principle in the air, for in all the voyage there was not one ſhower of rain; and the air could not be called moiſt, for there blew a conſtant levant, which is a drying wind; and ſalts of wormwood and aſh, tho' expoſed to the air, contracted no moiſture.

The wholeſomeſt way of drinking brandy with water is this, firſt take a mouthful of brandy, and while it is yet hot and unſwallowed in the mouth, drink the water and ſo waſh it down; for if you drink the water firſt, or mix the brandy with the draught

draught, it inſtantly imparts ſuch a chillneſs to the ſtomach and lungs, as cannot be corrected by the ſucceeding brandy.

As to the colour of the ſea, on that which was dark-coloured, the top of each wave, as it was caſt up before the ſun, ſhowed itſelf to be azure, the reſt approaching to black; and the ſea that was azure and tranſparent in ſun-ſhiny days, was black and dark-coloured, when the ſun did not ſhine; but in the green ſea there was not that difference.

As to thoſe plants, whoſe roots are ſtony, it may be noted, that ſome of their roots are wholly petrified, ſome only in part; the reſt being of a more vegetable conſiſtence, there are accretions of ſtone on the boughs, which are often looſe and moveable, like beads on a ſtring: Some of theſe trees are alſo like buck's-horns, with particular excreſcences beautified with ſtars.

Tho' the ſand percolate the water that is found in digging on the ſhore, yet it emits no ſteam into the air, notwithſtanding the heat of the country; for one may lie all night on the ſand without any harm; and weevils that breed in meal, currants, raiſins, *&c.* are driven out of them, by ſpreading a ſheet, in which their meal, *&c.* is contained, on the ſand heated by the ſun; upon which, theſe animals retire from the bottom to the upper parts, and there being heated, they are forced to quit the meal entirely; and tho' you ſpread the ſheet on the firm ground, never ſo much heated by the ſun, it will preſently grow damp there, and the weevils will lodge at bottom, ſo that there is no removing them but on the ſand: Alſo in the night between the earth and the pendulous hamacks, there is not only a greater coldneſs of air, but alſo a moiſture, than when one is in that poſition above the ſand.

Dr. *Stubbes* found M. *Lygon*'s aſſertion, *viz.* That a tortoiſe has three hearts, falſe; for tho' the ſhape and fleſh of the two auricles be ſuch, as to deceive the unwary, yet there is but one heart of a triangular form, and fleſhy; the two auricles move at a different time from the heart, and are at the diſtance of an inch from it, with a narrow fleſhy paſſage, by which the blood is impelled into the heart; this heart has but one ventricle, but it is furniſhed with ſeveral fleſhy columns and receptacles, ſuch as are not to be found in the auricles. The graſs of the ſea meadows is not a ſpan long, and of a green approaching to yellow; of this graſs they bite more than they ſwallow, ſo that the ſea, where they feed, is covered with it: Once in about half an hour, they come up, and fetch one breath like a ſigh, and then plunge again; but out of the water, they breathe ſomewhat oftner; if you hurt them as they lie on their backs a-ſhore, the tears will trickle

trickle from their eyes; you may keep them out of the water upwards of twenty days, and yet be so fat as to be fit to eat, provided you give them twice a-day about half a pint of salt water: The fat about their intestines is yellow, tho' that of the body be green; the head dies immediately, as soon as cut off; and if you take out the heart, the motion continues not long; but any part of the flesh will move, if prick'd, as also move of itself for many hours after it is cut into quarters, and the very joints of the bones of the shoulders and legs have their motion; and even the fat on pricking; but if you put these parts of the tortoise in the sun, they presently die; but the legs die, as soon as cut off. They float a-sleep in a calm day a long time, and the seamen rowing gently to them strike them with irons, or ensnare their legs with a rope and a running net; they have no swim-bladder.

The eggs of crocodiles and alligators are little bigger than turkeys; the shell is firm, and resembling in shape a turkey's, but not spotted: The stones found in the crocodile's stomach, are only such, as he swallows to promote digestion.

The shark-stone is a white substance resembling a brain; and encompassed with a transparent jelly, which dries all away, as it is exposed to the sun, and this white substance becomes a friable calx; it is taken out of two places over each eye: The shark, notwithstanding his vast strength, has no bone in his back; only in his head there are bones; his jaws are gristles; and he has rows of teeth, that are bones like lancets and moveable, so as to stand erect, or lie flat at pleasure; these rows multiply to four or five, as he grows in years; his back-bone is all gristly, as are also his ribs, yet the former is divided into *Vertebræ*; seamen usually cut them into walking staves. This fish and the dolphin, as also the *Spanish* maccarel, swim faster than any ship sails.

Civet-cats will live a month without drink, and so yield more civet, as also, if fed with fish: Yet, like rabbits, they make great discharges by urine: In places where it rains not for a month or longer, nor where any river or pond are to be found, cows lick the dew to supply that want.

Swallows in *Jamaica*, notwithstanding the heat there, depart in the winter months, and are succeeded by wild duck and teal.

The cabbage-tree is a kind of palm; what is eaten as cabbage, is what sprouted out that year, and so is tender; if eaten raw, it is as good as new almonds; and if boiled, exceeds the best cabbage: When that top is cut off, the tree dies; its timber never rots, and when dried, grows so hard, that a nail cannot be driven into it.

Tobac-

Tobacco, that grows in nitrous grounds, will not come to ſo good a colour, nor keep ſo long, as other tobacco; and potato's planted there, tho' they come to maturity a month ſooner than elſewhere, yet they inſtantly rot, if not uſed: Sugar-canes grow larger and faſter in ſuch ſoils, than elſe-where, but immediately rot, if not ground; and they boil not ſo well to ſugar. In *Jamaica*, the ſugar cures faſter in ten days, than in ſix months at *Barbadoes*; and that in ſuch places, wherein it rains for many months at the ſame time: There is an infinite variety in the grain and colours of wood; the timber of a tree, called *Baſtard-Cedar*, is ſo porous, that made into cups, wine and brandy will ſoak thro': There are ſeveral kinds of wood in the *Indies*, beſides the *Acajou* or *Cajous*; and there is alſo a tree in *Jamaica*, called *White-Wood*, that never breeds worms.

The berries of the ſoap-tree waſh better than any *Caſtile* ſoap, but in time rot the linnen; they are as big as muſket-bullets, and without any proportion of lixiviate ſalt, ſulphur, or oil.

In *Jamaica* are three ſorts of tanning barks, the *Mangrave*, *Olive-bark*, and another; they tann better than in *England*, and in ſix weeks the leather is fit to work into ſhoes.

The juice of *Manioc* or *Caſſavi*, is rank poiſon; hogs and poultry, that drink it, die immediately; the root, if roaſted, is not poiſonous, yet it cauſes the gripes.

The *Indians* uſe oil of *Palma Chriſti* for their lamps; it is delicate, ſweet, and tranſparent, of which this plant yields great quantities, and it might be made a ſtaple commodity; in head-aches, the *Indians* apply its leaves to the head, as the only remedy.

The *Manchinel*-tree is a wood of an excellent grain, equalling the *Jamaica* wood, and four foot in diameter.

The fat of the birds, called by ſome *Fregati*, and by us, *Men of War*, is good in aches, *&c.* as is that of alligators, or the ſhell-fiſh, called *Soldats*, or *Soldiers*.

The ſhining-flies of *Hiſpaniola* and *Jamaica* differ in bigneſs; they can contract and expand their light, as they fly, and they continue ſhining ſome days after they are dead.

Wood-lice gnaw books, and their covers; as alſo ſome ſorts of timber.

The *Cirons* or *Chegos*, are very painful, when they infeſt the nervous and membranous parts of the body, and cannot be taken out with a needle, for fear of pricking a nerve, and the hole that is made in other places for extracting them, is as large as a pea.

It

It is colder in hurricanes than at other times, and it is obſerved they ſhift not thro' all the points of the compaſs, but begin always with a north-wind, veer to the eaſt, and then ceaſe; and their ſhifting between theſe two points, is ſo ſudden and violent, that it is impoſſible for any ſhip to veer with it; whence it happens, that ſhips have their backs broken, and their ſails are carried away yards and all, and ſometimes the maſts themſelves wreathed round, like an oſier.

On our return to *England*, as we double cape *Antonio* in *Cuba*, there is a current betwixt that cape and the two capes of *Cartooche*, which ſometimes ſets weſt, and ſometimes eaſt; if it ſet eaſterly, ſhips have a quick paſſage in three or four days to the *Havanna*; otherwiſe, it is a fortnight or three weeks ſailing; in order to find out the ſetting of this current, they hoiſt out their boat, and rowing a little from the ſhip, they ſink their plummet 200 fathoms, and tho' it reach not the bottom, yet the boat will turn head againſt the current, and ride as firm, as if at anchor.

Change of climate, as we approach the *Tropic*, ſenſibly affects our bodies, for about that time, the men uſually fall ſick; but, by way of prevention, all the ſeamen and paſſengers let blood; which, however, is not to be raſhly done, for Dr. *Stubbes* found that the blood of the *Engliſh*, conſiſting of groſſer parts, and being extracted from a more ſubſtantial food, as fleſh did attenuate, and that the pulſe in ſome became very high, full, and quick; in others ſlow, yet higher and fuller than before; that ſome had a ſenſe of pricking, others a great dullneſs and oppreſſion of ſpirits; after which, they paſs into a ſweat, which continues for the time above mentioned. There were two patients in a diſeaſe, called a *Calenture*; one of them, all of a ſudden, imagined the ſea beſtrewed with green leaves, tho' it happened then to be of an azure colour; after that, he began to admire the fine woods, he fancied in proſpect; but all theſe imaginary ſcenes diſappeared, upon adminiſtring a vomit of glaſs of antimony in ſack; at night he took conſerve of roſes vitriolated, ſalt of wormwood, and *Diaſcordium*; next morning, he was blooded in the arm, and afternoon, in the forehead; his diet was water-gruel, with cream of tartar, and ſome prunes ſtewed; there was no fever perceivable in this diſeaſe, his pulſe being low, ſlow, and equal; he had no ſenſe of heat, no thirſt, nor was his tongue diſcoloured: The other patient in the *Calenture* imagined nothing but groves of oranges and lemons, and begged a boat with the greateſt earneſtneſs to go a-ſhore, and perhaps might have

leap'd

leap'd into the ſea, if not watched: The ſymptoms were the ſame as in the former, only his whole body ſeemed colder, yet he himſelf was not ſenſible of the leaſt coldneſs; he was vomited, and began to be well, all his fine imaginations vaniſhing, as ſoon as ever the vomit made him ſick at ſtomach; he was dieted as the former patient, and only blooded in the arm; they were both let blood out of precaution, for otherwiſe they ſeemed well, as alſo to promote perſpiration and ſweating, which accordingly ſucceeded.

He obſerved no good effect of the moſt innocent purge, during his ſtay in the *Indies*, except in chronical diſtempers, nor did he ever adminiſter any, but either antimonial pills, *Mercurius Vitæ*, or emetic infuſions.

All the phyſicians and ſurgeons at *Barbadoes* condemn the uſe of opium, as both ſtupefying and mortal; and he obſerved the *London laudanum*, which is an extract of opium with ſpirit of wine, to be very narcotic; but affirms that the *Laudanum ſimplex* of M. *le Fevre*, which is an extract of toaſted opium with diſtilled vinegar, and ſome other correctives, never ſtupefies, nor inclines to ſleep after taking, yet it eaſes every pain.

In going to the *Indies*, it is obſerved that lice diſappear in a certain degree of latitude, and return again in the ſame degree in the home voyage; and that none are found to be louſie in the *Indies*, how naſty ſoever, except it be in their heads; for when one approaches the *Long-reach* and *Tropic*, he begins to ſweat exceſſively, and this kills all theſe vermin.

Nothing is more uſual in the *Indies* than clyſters of brandy in the bilious colick, which make them drunk and ſtaring mad, as if ſwallowed down by the mouth: He affirms that he himſelf, in that diſtemper, had a nouriſhing clyſter, of half a pint of *Madera* ſack, warmed with the yolk of an egg and a little pepper, given him at night; which cheriſhed his bowels, and threw him always into a gentle ſleep and breathing ſweat for ſome hours.

A Sand Flood *at* Downham *in* Suffolk; *by Mr.* Tho. Wright, Phil. Tranſ. N° 37. p. 722.

IT is not yet 100 years ſince theſe ſands firſt broke looſe; their original is in a warren in *Laken-heath*, lying ſouth-weſt and by weſt of *Downham*, and at the diſtance of five miles; in this place are large ſand hills, whoſe ſwerd or ſurface of earth was broken off by violent ſouth-weſt winds, whereby the ſands were blown upon the adjacent lands, which alſo, being of the ſame nature, and having but a thin cruſt of barren earth to ſecure their

ſand, were ſoon broke up, and ſo contributed to encreaſe the maſs. At the firſt eruption, the whole quantity of ſand could not cover above eight or ten acres; but in the progreſs of four miles, it buried upwards of one thouſand. And all the oppoſition it met with, was from one farm houſe, that ſtood a mile and a half from its ſource: It is now between 30 and 40 years, ſince it firſt reached this town, where it continued for 10 or 12 years without doing any conſiderable miſchief, becauſe then its current was down hill, which ſheltered it from thoſe winds that gave it motion; but that valley being once paſt, it went above a mile up hill in two months time, and over-run 200 acres of very good corn: It is now got into the body of this little town, where it has buried divers tenements and other houſes, and deſtroyed all the meadows and paſtures about it: Yet ſome check has been given it by furze hedges ſet upon each other, as faſt as the ſand levelled them, by which there are ſand banks raiſed near 20 yards high, and by laying ſome hundred loads of muck, and good earth upon it, it is reduced to good land: The branch of the river *Ouſe*, on which *Downham* lies, is ſo filled up with ſand for three miles, that it is impaſſable for a veſſel of the leaſt burden: And had not the ſtream interpoſed to ſtop its paſſageinto *Norfolk*, it would alſo have over-run part of that country; for, according to the proportion of its increaſe in theſe five miles, which was from 10 acres to 1500 or 2000; in ten miles of the ſame ſoil, it would have reached to a great extent. The ſituation of the country, in which theſe ſands took their riſe, is eaſt-north-eaſt of a part of the great level of the *Fenns*, and is thereby fully expoſed to the rage of thoſe impetuous blaſts, which yearly blow from the oppoſite quarter, and which are ſuppoſed to become ſtronger by the winds paſſing thro' ſo long a tract without any check; another thing that contributes to it, is, the extreme ſandineſs of the ſoil, which gave occaſion to that ſtory of actions being brought in *Norfolk*, for ground blown out of the owner's poſſeſſion.

Magnetical Variations *and* Tides, *near* Briſtol; *by Capt.* Sam. Sturmy. Phil. Tranſ. N° 37. p. 726.

JUNE 13th, 1666, captain *Sturmy* made the following obſervations in *Rownham* meadows near *Briſtol*, by the water ſide.

Sun's altitude.		Magnetical Azimuth.		Sun's true Azimuth.		Variation Weſterly.	
deg.	m.						
44	20	deg.	m.	deg.	m.	deg.	m.
39	30	72	00	70	38	1	22
31	50	80	00	78	25	1	36
27	42	90	00	88	26	1	34
23	20	95	00	93	36	1	24
		103	00	101	23	1	23

In

In this table, the greateſt difference of variation is 14′, and taking the mean, for the true variation, he concludes it to be 1° 27′. He made the ſame obſervations *June* 13th, 1667, and found the variation encreaſed about 6′ to the weſt.

Capt. *Sturmy* aſſures from many obſervations, that the greateſt ſpring and annual tides there, are about the equinoxes, according as the moon is near the full or change, before or after that time.

An eaſy Help for Decayed Sight. Phil. Tranſ. N° 37. p. 727.

THE inventor of this method was about 60 years of age, his ſight was much decayed, and he ſeemed to obſerve a thick ſmoke or miſt about him, and little black balls dancing in the air before his eyes; he could not diſtinguiſh the faces of his acquaintance, nor men from women, nor keep the plain trodden road, unleſs he was led; glaſſes afforded no relief, the faireſt prints ſeemed thro' ſpectacles like blind prints: At laſt he fell upon the following expedient; he took ſpectacles of the largeſt circles; then taking out the glaſſes, he put black *Spaniſh* leather taper-wiſe into the empty circles, and by applying his eye to the wider end, he could read the ſmalleſt print thro' the narrower extremity: Theſe empty tubes were made of different lengths, and the ſmaller ends of different bigneſſes; only obſerving, that the ſmaller the remote orifice was, the fairer and clearer the ſmalleſt prints appeared; and the wider it was, the larger object it took in, and ſo required the leſs motion of the hand and head in reading; ſometimes he uſed one eye, ſometimes another, and thus relieved them by turns; for the viſual rays of both eyes cannot meet in reading, when thus divided by tubes of that length. The lighter the ſtuff of which the tubes are made, the leſs cumberſome they prove; the inſide is to be blackened with ſomething that has no luſtre or glittering; and they ſhould be ſo contrived as to be moveable, that they may be lengthened or ſhortened, and the orifice made narrower or wider, as will be found moſt convenient. Probably, theſe tubes may be proper for thoſe that are ſquint-eyed, whoſe eyes interfere; but undoubtedly they will yield great eaſe to ſuch as cannot well bear the light, and perhaps preſerve the ſight for a longer time. All the trouble is in uſing them for the firſt time, for afterwards by a little practice they become very eaſy.

Upon putting convex-glaſſes into the tubes, he found the prints, tho' ſomewhat larger, yet not ſo clear and diſtinct, as when he uſed the empty ones: He alſo found thoſe leathern

tubes the beſt, that were not faſtened to the bone of the ſpectacles; for as they hang in that ſlight manner, they may be raiſed or bent down with a touch of the finger, and divided or united to take in the ſame object.

Of the Antiquity of the Transfuſion *of* Blood *from one Animal to another.* Phil. Tranſ. N° 37. p. 731.

THERE has been ſome diſpute about the origin of transfuſion; both the *Engliſh* and *French* putting in their claims to the invention, the latter pretending that they had known it 10 years ſince, *viz.* before 1668; but there are good proofs that the former were maſters of it, 30 years before that date: However, a late *Italian* author undertakes to prove, transfuſion to be of greater antiquity, as having been known to *Libavius* upwards of 50 years ago; and there is a paſſage in this author's *Defenſio Syntagmatis Arcanorum Chymicorum, actio* 2. *p.* 8, wherein transfuſion is deſcribed in the plaineſt terms poſſible; " *Adſit* (ſays he) *juvenis robuſtus, ſanus, ſan-*
" *guine ſpirituoſo plenus: Adſtet exhauſtus viribus, tenuis,*
" *macilentus, vix animam trahens: Magiſter artis habeat*
" *tubulos argenteos inter ſe congruentes, aperiat arteriam robuſti*
" *& tubulum inſerat muniatque; mox & ægroti arteriam findat,*
" *& tubulum fæmineum infigat: Jam duos tubulos ſibi mutuo*
" *applicet, & ex ſano ſanguis arterialis, calens & ſpirituoſus*
" *ſaliet in ægrotum, unâque vitæ fontem afferet omnemque lan-*
" *guorem pellet*": That is, take and transfuſe the blood of a ſound, robuſt, and ſanguine young man, into a perſon, who is mere ſkin and bones, whoſe ſtrength is quite exhauſted, and who with difficulty can fetch his breath; for this end, let the operator open an artery in both, and inſert his ſilver pipes into 'em, of ſuch a length as to enter into each other; then the arterial, warm and ſpirituous blood of the ſound perſon will flow into the other, and at once convey the ſpring of life, and baniſh every languor.

A Method of making the Picture *of any Thing appear in a light Room; by Dr.* Hook. Phil. Tranſ. N° 38. p. 741.

MAKE a hole of about a foot in diameter, or bigger, oppoſite to the place, or wall, where you deſign the picture; without this hole place the object you would repreſent, in an inverted poſition, and by means of looking glaſſes ſet behind it, if the object be tranſparent, reflect the rays of the ſun, in ſuch a manner, that they may paſs thro' it, towards the

place where it is to be repreſented, and let it be ſurrounded on every ſide with a board or cloath, that no rays may paſs beſide it; if the object be a ſtatue, or living creature, it muſt be very much enlightened, by throwing the ſun beams upon it by refraction, reflexion, or both; then place a broad convex-glaſs between the object, and where it is to be repreſented, that the picture may be formed diſtinct; the nearer its ſituation is to the object, the more is the picture magnified on the wall, and the further off, the leſs: If the object cannot be inverted, as is the caſe in living animals, and candles; then let two large glaſſes of convenient ſpheres be ſo poſited at proper diſtances, to be found out by trials; that the repreſentations may be as erect, as the objects themſelves.

The ſeveral objects, the reflecting, and refracting glaſſes, and the whole apparatus, as alſo the perſons employed in managing them, muſt be placed without the hole, ſo as not to be obſerved by the ſpectators in the room.

The ſame thing may be done with much more eaſe in the night time, with torches, lamps, or other lights planted about the objects.

Of Counterfeiting Opal; *by Mr.* S. Colepreſs. Phil. Tranſ. N° 38. p. 743.

AT *Harlem* they make counterfeited opal-glaſs, which is very lively, and, whoſe ſeveral colours are ſuppoſed to be produced by different degrees of heat; when the compoſition is thoroughly melted, ſome of it is taken out on the point of an iron rod, which being cooled either in the air or water, is colourleſs and pellucid, but being put again into the mouth of the furnace upon the ſame rod, and turned round for a little time, its particles acquire ſuch various poſitions, as that the light falling on them, being variouſly modified, repreſents the ſeveral colours obſervable in the true opal; and it is remarkable that theſe colours may be deſtroyed and reſtored again by different degrees of heat.

The Quadrature of the Hyperbola; *by Dr.* Wallis *taken from* N. Mercator's Logarithm. Technia *in* Latin. Phil. Tranſ. N° 38. p. 753.

THE following quadrature of the hyperbola is very elegant and ingenious. After M. *Mercator* had demonſtrated prop. 14, that, in the hyperbola M B F (Fig. 11. Plate IV.) whoſe

whoſe aſſymptotes AN, AH form a right angle, the rectangles BIA, FHA, SpA, &c. after drawing BI, FH, Sp, &c. parallel to the aſſymptote AN, are mutually equal, and conſequently their ſides reciprocally proportional; which is the known property of the hyperbola: Making AI $=$ BI $=$ 1, and HI $= a$;

he ſhows prop. 15, that FH $= \frac{1}{1+a}$, becauſe that AH : AI :: BI : FH. *i. e.* $1+a : 1 :: 1 : 1\frac{1}{+a}$; which is equal to $1 - a + a^2 - a^3 + a^4$, &c. And ſince this will equally hold at what diſtance ſoever H be put beyond I, putting AI, as before $=$ 1, and making any production of it, as Ir $=$ A, which may be ſuppoſed to be divided into innumerable equal parts, each of which as Ip, pq, &c. may be deſigned by a; therefore let Ip, Iq, &c. be a, $2a$, $3a$, &c. till the ſeries terminate in A: the right lines ps, qt, &c. anſwering to theſe, comprehending the ſpace BIru are

$$1 - a + a^2 - a^3 + a^4, \text{ \&c.}$$
$$1 - 2a + 4a^2 - 8a^3 + 16a^4, \text{ \&c.}$$
$$1 - 3a + 9a^2 - 27a^3 + 81a^4, \text{ \&c.}$$

And ſo on to $1 - A + A^2 - A^3 + A^4$, &c.

Since then, $1 + 1 + 1 + 1$, &c. to the laſt term $= A$

$$a + 2a + 3a, \text{ \&c. to } A = \tfrac{1}{2} A^2$$
$$a^2 + 4a^2 + 9a^2, \text{ \&c. to } A^2 = \tfrac{1}{3} A^3$$
$$a^3 + 8a^3 + 27a^3, \text{ \&c. to } A^3 = \tfrac{1}{4} A^4$$

&c. &c. &c.

from this he rightly infers prop. 17 that the hyperbolic ſpace BIru is $= A - \frac{1}{2} A^2 + \frac{1}{3} A^3 - \frac{1}{4} A^4 + \frac{1}{5} A^5$, &c. wherefore, aſſigning A $=$ Ir any value in numbers, and diſtributing into two claſſes the affirmative powers, A, $\frac{1}{3} A^3$, $\frac{1}{5} A^5$, &c. and the negative powers, $\frac{1}{2} A^2$, $\frac{1}{4} A^4$, &c. the aggregate of the latter being ſubtracted from that of the former, the remainder will be the hyperbolic ſpace BIru.

If you put A $=$ 0, 1. or $=$ 0, 21, or any other decimal fraction, and conſequently leſs than 1. that is taking Ir leſs than AI $=$ 1, the laſt powers of A become ſo ſmall, that they may be neglected, *e. gr.* putting AI $=$ 1 and Ir $=$ 0, 21, then

A $=$

$A = 0,21$	
$\frac{1}{3}A^3 = 0,003087$	$\frac{1}{2}A^2 = 0,02205$
$\frac{1}{5}A^5 = 0,000081682$	$\frac{1}{4}A^4 = 0,000486202$
$\frac{1}{7}A^7 = 0,000002572$	$\frac{1}{6}A^6 = 0,000014294$
$\frac{1}{9}A^9 = 0,000000088$	$\frac{1}{8}A^8 = 0,000000472$
$\frac{1}{11}A^{11} = 0,000000003$	$\frac{1}{10}A^{10} = 0,000000016$
$+0,213171345$	$-0,022550984$

$= BIru$ $= 0,190620361$

But if the quadrature of the whole ſpace BIHF whoſe ſide IH is longer than AI, were required, this method would not ſucceed ſo well, for in that caſe A being greater than 1, it is plain that the laſt powers would be too conſiderable to be neglected, to remedy which, ſuppoſe the ſpace HFur was to be ſquared, and let AH be of any length, as either greater, leſs or equal to AI, and taking the point r any where between A and H, let $AH = 1$, and $Hr = A$, which is to be ſuppoſed as divided into innumerable equal parts, each of which $= a$; ſince $AH = 1$ the other parts decreaſing continually, $1 - a$, $1 - 2a$, $1 - 3a$, &c. to $Ar = 1 - A$; likewiſe, becauſe of the equal rectangles FHA, urA, BIA, &c. which ſuppoſe $= b^2$; $HF = \frac{b^2}{1}$ and all the reſt $\frac{b^2}{1-a}$, $\frac{b^2}{1-2a}$, $\frac{b^2}{1-3a}$, &c. to $ru = \frac{b^2}{1-A}$ comprehending the ſpace HFur, as appears from *Wallis Arithm. infinit. prop.* 88. 94, 95: And dividing b^2 by $1 - a$, the quotient will be $b^2 + b^2a + b^2a^2 + b^2a^2 + b^2a^3 + b^2a^4$, &c. that is, $= b^2 \times 1 + a + a^2 + a^3 + a^4$, and all the other right lines between HF and ru will be

$$\left.\begin{array}{l} 1 + a + a^2 + a^3 + a^4, \text{ \&c.} \\ 1 + 2a + 4a^2 + 8a^3 + 16a^4, \text{ \&c.} \\ 1 + 3a + 9a^2 + 27a^3 + 81a^4, \text{ \&c.} \\ \text{And so on to } 1 + A + A^2 + A^3 + A^4, \text{ \&c.} \end{array}\right\} \times b^2$$

And the ſum $A + \frac{1}{2}A^2 + \frac{1}{3}A^3 + \frac{1}{4}A^4 + \frac{1}{5}A^5$, &c. $\times b^2 = FHru$ by *Arith. infinit. prop.* 64.

E. gr.

E. gr. Let $AH = 1$, $Hr = A = 0, 21$, $AI = b = 0, 1$, and therefore $b^2 = 0, 01$, then

$$\begin{aligned}
A &= 0,21 \\
\tfrac{1}{2}A^2 &= 0,02205 \\
\tfrac{1}{3}A^3 &= 0,003087 \\
\tfrac{1}{4}A^4 &= 0,000486203 - \\
\tfrac{1}{5}A^5 &= 0,000081682 + \\
\tfrac{1}{6}A^6 &= 0,000014294 + \\
\tfrac{1}{7}A^7 &= 0,000002573 - \\
\tfrac{1}{8}A^8 &= 0,000000473 - \\
\tfrac{1}{9}A^9 &= 0,000000088 + \\
\tfrac{1}{10}A^{10} &= 0,000000017 - \\
\tfrac{1}{11}A^{11} &= 0,000000003 +
\end{aligned}$$

their Sum $- 0, 235722333 \times b^2 = - 0, 01 = 0, 00235722333 = FHru$, of which $1 = AHGN$ a square, if A be a right angle, or a rhombus if A be an oblique angle; all which may not only be accommodated to the construction of logarithms, but also for finding their sum; for putting $AH = 1$, $AI = IB = b$, and the plane $BIHF = pl.$ $pl - b^2 + b^3$ will be $= BIpS + BIqt + BIru$, &c. till it terminate in $BIHF$; if you begin not at BI, but on either side of pS; putting $pH = a$ and $pSFH = pl$, it will universally hold, $pStq + pSur$, &c. to $pSFH = plane - ab^2$, of which $1 = AH^3$.

Experiments of infusing Medicines *into Human Veins.* Phil. Transf. N° 39. p. 766.

M. *Smith* physician at *Dantzick* injected alterants into the veins of three persons, the one, lame of the gout, the other, extremely appoplectical, and the third, troubled with that odd distemper, the *plica polonica*: The success of this was; that the gouty man found himself well next day, and shortly after went to work; the appoplectical patient has had no paroxysm since; and the several sores caused by the *plica polonica* are healed.

A further Account of the Mendip Mines; *by Mr.* Glanvil. Phil. Transf. N° 39. p. 767.

MR. *Glanvil* says, he has been informed by experienced miners, that the veins sometimes run up into the roots of trees, yet they observed no difference at the top, with respect to

to the other trees, into whoſe roots no ſuch veins run; the water is eſteemed healthy to drink, and to dreſs meat in; the ſnow and froſt near the groves melt quickly, but continue longer at greater diſtances; when a mine is very near the ſurface, the graſs is obſerved to be yellow and diſcoloured. Some uſe the *Virgula divinatoria*; but experienc'd workmen have no value for it; yet they ſay, when the mine is open, they may gueſs by it, how far the vein leads: White, yellow, and mixt earth are leaders to the country, as they call it; changeable colours always encourage their hopes: They ſometimes dig twelve fathom deep, before they meet any ſtones; at other times, when there is a ſtony-reak at top, they light on the ore juſt under the ſwerd or ſurface of the graſs, and which reaches down to 40 fathoms; a black ſtone is a bad preſage, for it leads to a *Jam*, which is a black thick ſtone, that hinders their work; a grey clear dry one, they account beſt; they ſeldom meet with damps; if in ſinking, they come to wet mooriſh earth, they look for a *Jam*, and expect to be cloſed up with rocks; they gueſs at the nearneſs by ſhort brittle clay, for the tough is not leading. The ore is ſometimes ſhallow and ſometimes 14 or 20 fathoms deep; they follow a vein inclining to ſome depth, when it runs away in flat binns; their draughts are 14 or 16 fathom, till they come to a ſtone, where they caſt aſide a draught called a cut: Then they ſink plum again four or five cuts, one under another; they find ore at 50 fathom; their beſt reaks are north and ſouth; eaſt and weſt are good, tho' not ſo deep. The groove is 4 foot long, 2 ½ foot broad, till they meet a ſtone, when they carry it as far as they can; the groove is ſupported by timber; and which laſts very long, for that which has been uſed for above 200 years, will ſerve in new works; it is tough and black, and being expoſed for 2 or 3 days to ſun and wind, will ſcarcely yield to an ax. For the ſupply of freſh air, they have boxes of elm exactly cloſed, of about ſix inches in the clear, by which they carry it down above 20 fathoms; but when they come to ore, and need an air-ſhaft, they ſink it at the diſtance of four or five fathoms, and of the ſame faſhion with a groove, for drawing ore as well as air. They uſe leathern bags of 8 or 9 gallons each, and pulled up by ropes, to drain the water: If they find a *Swallet*, they drive an adit on a level, till it is dry. If they cannot cut the rock, they anneal it with fire, laying on wood and coal, and the fire is ſo contrived, that they leave the mine before the operation begins, and they find it dangerous to enter again,

 before

before it is quite cleared of the ſmoak, it proving mortal to ſome. Their beetles, axes, wedges, *&c.* unleſs they are ſo tempered, as to make an impreſſion on the head of an anvil, are not fit for their purpoſe; and yet they ſometimes break them in an hours time, and others laſt three or four days. They work in frocks and waſte-coats, by tallow candles, 14 or 15 to the pound, and if they have air enough, a candle laſts three hours. When a vein is loſt, they drive two or three fathoms in the breaſt, as the nature of the earth directs them: They convey out their materials in elm-buckets pulled up by ropes, holding about a gallon; and they make their ladders of ropes. The ore ſometimes runs in a vein, and ſometimes diſperſed in banks; it often lies between rocks, being ſometimes hard, and ſometimes milder; they have often branched ore in the ſpar; there is about the ore, ſpar, chalk, and ſoft mealy white ſtone, marted with ore, and called *Crootes*; the ſpar is white, tranſparent, and brittle as glaſs; the chalk white and heavier than any ſtone; the vein lies between the coats, and is of different breadths; it breaks off ſometimes in an earth, called a *deading bed*, and may be found again in the ſpace of a fathom or two, keeping the ſame direction; it ſometimes terminates in a dead clayey earth, without croot or ſpar, and ſometimes in a rock, called a *fore-ſtone*. The cleareſt and heavieſt ore is the beſt; 36 hundred weight may yield a tun of lead. They beat the ore with a flat iron, cleanſe it in water from the dirt, ſift it thro' a wire-ſieve, the ore falls to the bottom, and the refuſe lies at top: And theſe are the preparations previous to its fuſion; for that purpoſe they have a hearth about five foot high, ſet on timber, and to be turned round like a wind-mill, to avoid the inconvenience of ſmoak, upon the ſhifting of the wind; the hearth contains half a buſhel of ore and coal, with bellows on the top; the charcoal is laid upon the hearth, where the ore is, and dry gadds at top, called white coals; on the ſide of the hearth is a ſink, that holds about 1 $\frac{1}{2}$ hundred, into which the lead runs; then it is caſt into ſand, in which it forms itſelf into *ſows*; they have a bar to ſtir the fire, a ſhovel to throw it up, and a ladle heated red hot, to throw out the melted metal. One melting is ſufficient, and the beſt, which is diſtinguiſhed by its weight, melts firſt. There is a *flight* in the ſmoke, which, falling on graſs, poiſons cattle, it is ſweet upon the lips; if carried home, it will kill rats and mice; and if it is mixt with a running ſtream, it will poiſon cattle, even after a courſe of 3 miles; what of this *flight* falls on the ſand,

they

they gather up to melt in a flag-hearth, and make ſhot and ſheet lead of it. They ſometimes find ſlags, four or five foot under ground. As to ſubterraneous Dæmons they never ſaw any, but ſometimes they have heard knockings beyond their own works, which when followed, afforded plenty of ore. And one *King* of *Wells* found in his groove a piece of ore, in which they fancied the ſhape, eyes, arms, legs, full breaſt of a man, *&c.* it was about four inches in length, and the mine proved rich.

Oſteocolla *about* Frankfort *on the* Oder *and an extraordinary Sort of* Snow; *by* J. Chriſtopher Beckman. Phil. Tranſ. N° 39. p. 771.

O*Steocolla* or glue-bone is found to grow in a ſandy, yet not gravelly ſoil, and not at all, as far as is known, in any rich or clayey ground; it ſhoots into the earth about 10 foot; the branches grow commonly ſtreight, and ſometimes they ſpread ſidewiſe; ſome of them are thicker, and ſome more ſlender, eſpecially as they are more diſtant from the common ſtem, which laſt is uſually of the thickneſs of an ordinary arm or leg, and the branches as thick as one's little finger: On the ſand, which is every where elſe yellowiſh, appears a whitiſh fatty ſand, which, if dug into, has under it a dark, fatty, and ſomewhat moiſt and putrid matter, like rotten wood, and called the flower of the *Oſteocolla*; the *Oſteocolla* being thus found, is entirely ſoft, yet, rather friable than ductile; wherefore, to get it whole with its branches out of the earth; the ſand muſt be carefully removed, and being expoſed to the ſun for half an hour or longer, it grows as hard as it is found in the ſhops; it ſeems to be a kind of marl, or to have great affinity to it.

The ſame gentleman obſerved an unuſual ſort of ſnow, it had none of the ordinary figures, but was made up of little pillars; ſome whereof were tetragonal, and ſome hexagonal, with a neat baſis; on the top they were ſomewhat larger, like the heads of columns; it may properly enough be called *nix columnaris.*

The Virtue of Antimony. Phil. Tranſ. N° 39. p. 774.

UPON giving an ounce at a time of crude antimony to a boar, and putting him into the ſtye, it was obſerved he would fatten a fortnight before another that had no antimony; it was likewiſe found antimony will cure a pig of the meaſles,

whence it appears to be a great purifier of the blood; a lean and ſcabby horſe, that could not be fattened by any keeping, on giving him antimony every morning for two months, became exceeding fat, and upon the ſame keeping as formerly; a horſe, with running legs, after the *faſcines*, was cured by giving antimony for a week.

The manner of uſing it is this: Take a drachm of powdered crude antimony for one horſe, and ſhake it among his oats in a morning, or make it into balls.

Magnetical Variations *predicted*; *by Mr.* Hen. Bond. Phil. Tranſ. N° 40. p. 789.

MR. *Bond*, having formed to himſelf an hypotheſis of the variations of the needle has, in order to verify that ſuppoſition, calculated the following table.

Years	Variat. weſt	Years	Variat. weſt.	Years	Variat. weſt
1668	1° 56′	1703	7° 36′	1710	8° 33′
1670	2 18	1704	7 45	1711	8 41
1680	4 00	1705	7 50	1712	8 49
1690	5 39	1706	8 1	1713	8 56
1700	7 10	1707	8 9	1714	9 4
1701	7 19	1708	8 17	1715	9 11
1702	7 28	1709	8 25		

The true uſe of the Lymphatic Veſſels; *by* M. Louis de Bills. Phil. Tranſ. N° 40. p. 791.

THE lymphatic veſſels have two coats, between which are innumerable very ſmall and fine filaments, reſembling the moſs of trees, and without any valves, containing a nutricious juice conveyed into all the parts of the body, by a motion from the centre to the circumference; which returning again by the internal pipes, that are furniſhed with valves, is then no longer lymph, but ferment; which preſerves and ferments the blood, being conveyed into it by a motion contrary to the former, *viz.* from the circumference to the center.

M. *de Bills* affirms to have ſhowed, that theſe filaments carry their lymph to the glands, between the two coats, and that at the loweſt extremity of theſe glands, the ferment-veſſels take their riſe: He alſo affirms, that the greateſt part of the chyle is diſcharged between the tunicles of the veins, arteries, lymphatics, membranes and veſſels in the meſentery, to be conveyed into all parts of the body, both external and internal.

Of

Of the Tides, Whales, *&c. at* Bermudas; *by Mr.* R. Stafford. Phil. Tranſ. N° 40. p. 792.

THE tides at *Bermudas*, riſe not above five foot, and that only at one ſeaſon of the year, *viz.* between *Michaelmas* and *Chriſtmas*; at other times not above three foot. It is high water about an hour after the moon's riſing, and an hour after her ſetting; it flows in from the north-weſt, and runs nearly ſouth-eaſt; and it is high water ſooneſt in that part that lies moſt to the north-weſt; but the tides do not ebb and flow that courſe quite round the coaſt, which may be owing to points of lands or ſhallows, that divert its north-weſt and ſouth-eaſt courſe.

There are great numbers of whales about *Bermudas* in *March*, *April*, and *May*: The females have plenty of milk, which their young ones ſuck out of teats, that grow by their navels; they have no teeth, yet they feed on moſs growing on rocks at the bottom of the ſea, for the above mentioned three months, and no other ſeaſon of the year; and when that is eaten up, the whales retire; theſe they kill, on account of their oil; there have been *Sperma ceti* whales driven on the ſhore, which *Sperma* covers all their body; they have ſeveral teeth, about as big as a man's wriſt; are extraordinary fierce and ſwift, ſtrong and inlaid with ſinews all over their body, which may be drawn out to the length of 30 fathoms.

Some of the inhabitants live to upwards of 100 years, and many to 100, and they die of age and weakneſs rather than any diſeaſe; the air is ſweet and pleaſant, and the diet coarſe.

Spiders ſpin their webs here, between trees that ſtand ſeven or eight fathoms aſunder, which they do by darting them into the air, and the wind carries them from one tree to another; this web, when finiſhed, will enſnare a bird as big as a thruſh.

The houſes are thatch'd with the leaves of the *Palmetto*, ſome of which are eight or ten foot long, and near as broad.

Of poliſhing Glaſſes *by a turn Lath, and of an extraordinary burning* Glaſs. Phil. Tranſ. N° 40. p. 795.

AT *Paris* there is an artiſt, who poliſhes optic glaſſes on a *Turn Lath*, with the ſame facility as he turns wood.

Signor *Seltalla* cauſed a burning glaſs, of ſeven foot in diameter, to be made at *Milan*; he pretends to make it burn at the diſtance of 33 foot.

Of

Of the Cochineel Fly. Phil. Tranſ. N° 40. p. 796.

IT is generally thought, that the cochineel comes out of a fruit called the prickle-pear, having a leaf of a ſlimy nature, and a blood-red fruit, full of ſeeds, which give a dye almoſt like *Braſiletto* wood, that periſhes in a few days by the fire; but the inſect ingendred of this fruit or leaves, gives a permanent tincture, as is generally known.

There is a berry in *Bermudas* and *New England*, called the *Summer-Iſland Reed-weed*, as red as the prickle-pear, giving much the ſame tincture, out of which come worms, that afterwards turn to flies, ſomewhat bigger than the cochineel-fly, and feeding on the berry; and ſaid to yield a colour no ways inferior to that of the cochineel, and much exceeding it in medicinal virtue: It might be offered to try, whether this berry might not grow in *England*; and whether of the berry of *Braſiletto* wood a-like inſect might not be obtained in reſpect of colour; and whether a fading tincture, yielded by ſome vegetables, might not be fixed, by cauſing ſuch a fermentation, as might engender inſects, giving the colour of their original, that would hold in grain; in order to breed inſects out of herbs, for it is they that yield the beſt tincture, dry them, or ſtamp them till they run no more juice, and let them dry in the ſun, or in a proportionable heat; or if already dried, infuſe them in water, in a ſand heat for 24 hours; then evaporate the water, till the infuſion be as thick as a ſyrup; but for this uſe, ſtrain them not from their fœces; then take this maſs, and put it into an earthen or wooden veſſel covered with ſtraw, but not too cloſe, ſo as to exclude the air entirely; then put the veſſel in a pit in a ſhady place, and put about it ſome wet leaves, or ſome ſuch putrefying ſtuff, and over it a board, and on that, ſome ſtraw or the like; and it will produce a ſhelly worm, and then a fly of the tincture of the concrete, but more laſting, and ſomewhat heightening. As for berries, ſtamp and boil them, evaporating them to the conſiſtence of a thick juice, and do with them as above. As for woods, infuſe them in water, after pulverizing them, and boil out their tincture, and evaporate the water to the ſame conſiſtence as above. The flies will play about the ſide of the veſſel, and the ſurface of the matter; theſe you are to take, and kill in a warm pan or ſtove, and ſo dry and keep them.

A Bullet

A Bullet *voided by Urine*; *by Dr.* Nath. Fairfax. Phil. Tranf. N° 40. p. 803.

ONE *G. Eliot* of *Mendlesham* in *Suffolk*, being afflicted for many years with gripings in the bowels, was perfuaded to fwallow two bullets, whereupon fhe found immediate eafe; but afterwards her pains returned and increafed; in the fit was adminiftred to her a dofe of lady *Holland's* powder in poffet drink, which wrought gently; but fhe paft that night in exceffive pains with vomitings; and next morning fhe difcharged by urine a gravelly ftone, of a colour between yellow and red, but on ftriking off its outer cruft with a hammer, they found it to be a bullet of a brafs colour; on the outfide, and on cutting into it with a knife, it proved to be lead, which being difcovered, could eafily be accounted for.

The doctor would from this inftance infer, that there is a paffage from the ftomach to the bladder, befides what anatomifts have hitherto accounted for; for it feems to be beyond difpute, that the bullet came not to the *Ureters*, by the veins, arteries, nerves, or lymphæducts; and what confirms fuch a paffage from the ftomach to the bladder, is, that many find, that on drinking four or five glaffes of *Rhenifh* wine, within lefs than a quarter of an hour, they will have a ftrong inclination to make water, efpecially if the body has been a little in motion: Now, it feems fcarce conceivable, that it fhould pafs thro' the lacteals, veins, heart, and arteries, and be fecreted from the blood in fo fhort a compafs of time.

Tides *obferved in* Hong-road, *four Miles from* Briftol; *by Capt.* Sam. Sturmy. Phil. Tranf. N° 41. p. 813.

CAPT. *Sturmy* obferved the annual fpring-tides to fall out in *March* and *September*, either at that tide immediately preceeding the fun's ingrefs into the equinoctial points of *Aries* and *Libra*, or the next tide after, according as the moon, at that time, is near her full or change; and then the tide rifes to about 7 ½ fathoms, or 45 foot; and the loweft neap-tides are at 25 foot. The loweft neap makes the higheft fpring, unlefs the north-eaft winds blow hard, and fo keep back the tides; and the contrary winds, if they alfo blow hard, make the higheft. The diurnal tides, from about the latter end of *March*, till the latter end of *September*, are about a foot and three inches higher in the evening than in the morning; that is, if it be high-water after the fun is paft the meridian, or in the tides between noon and midnight; but

but from *Michaelmas* to *Lady-day* the contrary is obſerved, the day tides being then higher by 15 inches than the night tides, or the tides between midnight and noon; and this proportion holds in both, after the gradual increaſe of the tides from neap to higheſt ſpring, and the like decreaſe of their height till neap again. The higheſt menſtrual ſpring-tide is always the third after the full or change; unleſs it be kept back by north-eaſt winds. It has been often obſerved here, that it flows at change, when the moon is eaſt-ſouth-eaſt, the tide flowing in for five hours, and ebbing ſeven hours; ſo that there is 1 ½ hours difference by the old tables, which ſay, it flows only to the moon's being eaſt and weſt; an error that ought by all means to be corrected. There is ſome odds in reckoning the tides by the moon's bearing at full or change; for about that time, only the rule will hold; but from the change to the quarters, and from the full to the quarters again, in the neap-tides, it does not flow here ſo long by two points of the compaſs. It neither flows nor ebbs equal ſpaces in equal times; but its velocity is greateſt, at the beginning both of flood and ebb, and ſo gradually decreaſes to full or low water; and this is obſervable in the ſpring-tides only, as may be ſeen by the following table,

	Time.	Height.
	h. m.	f. inch.
Flowing	0 15	2 7½
	0 30	2 6
	0 45	2 6
	1 00	2 6
	0 15	2 6
	0 30	2 5½
	0 45	2 5
	2 00	2 5
	0 15	2 3
	0 30	2 3
	0 45	2 3

	Time.	Height.
	h. m.	f. inch.
Flowing	3 00	2 3
	0 15	2 2
	0 30	2 1
	0 45	2 1
	4 00	2 1
	0 15	1 9
	0 30	1 8
	0 45	1 8
	5 00	1 8
	5 00	44 1

	Time.	Height.
	h. m.	f. inch.
Ebbing	0 15	2 7½
	0 30	2 6
	0 45	2 6
	1 00	2 6
	2 00	9 0
	3 00	8 0
	4 00	6 0
	5 00	5 0
	6 00	4 0
	7 00	3 0
	7 00	44 10½

The uſual number of tides from one new moon to the ſucceeding, or from full to full, is 59. In the *Severn*, 20 miles above *Briſtol*, near *Newnham*, and 160 miles from its mouth, the head of the flood, in ſpring-tides, riſes nine foot high, like a wall, and ſo runs for many miles together, covering all the ſhallows that were dry before; and then all ſuch veſſels as lie in the way of theſe head-tides or *Boars*, as they are popularly called, are commonly overſet, or driven on the banks: It flows there only for two hours, and 18 foot high, and it ebbs 10 hours.

Obſer-

Observations in a Voyage *from* Spain *to* Mexico. Phil. Transf. N° 41. p. 817.

THIS observer gives an account of a famous cave, some leagues to the north-west of *Mexico*, gilded all over with a kind of leaf-gold, which had deluded many *Spaniards* with its promising colour, for they could never reduce it into a body, either by quickfilver or fusion; and going one morning thither, with an *Indian* for his guide; he found its situation somewhat high, and in a place very proper for the generation of metals; as he entred into it, the light of the candle soon discovered on all sides, but especially over his head, a glittering canopy of these mineral leaves; at which he greedily snatching, there fell down a vast lump of sand, that not only put his candle out, but almost blinded him: And calling out with a loud voice to his *Indian*, who stood at the entry of the cave; as being afraid of spirits and hobgoblins; there rebounded within those hollow caverns such thundring and redoubled echo's, that the *Indian*, imagining he had been wrestling with some infernal ghosts, soon quitted his station, and thereby left a free passage for some rays of light to enter, and to serve him for a better guide; his sight was a little affected by the corrosive acrimony of that mineral dust; but upon re-lighting his candle, he proceeded in the cave, and heaped together a quantity of the mineral mixt with sand, and scraped off from the surface of the earth some of the glittering leaves, none of which exceeded the breadth of a man's nail; with the least touch, they were divided into many lesser spangles, and with a little rubbing they left his hand all gilded over. He began to make experiments on the sand, which had been the matrix of the mineral, after the ordinary way used in the *Indies*, which was, to put it into a strong reverberatory fire, and observe the colour of the fumes; but on account of its adust driness, it afforded none; then he proceeded to another method, which was to boil it in water; and observing the *Alcali*, left after evaporating the water, he found, that it abounded rather in a sulphurous unctuosity, than a saline acrimony; upon this, he applied first the quickfilver, mingled with the ordinary magisteries of that country, to curb and break the force of the sulphur; but perceiving these ineffectual, he quickened the mercury with the *Caput Mortuum* of vitriol and saltpetre, a secret among miners, but without any success; then he boiled the mixture over the fire, but all to no purpose; so froward was it, that it could not be brought to receive mercury, either by fair or foul means: At

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laſt he tried it with a corroſive of ordinary ſeparating water, impregnated with common ſalt, and it made a ſolution, like that of gold; but on evaporating the *Aqua-fortis*, there only remained behind a yellowiſh dirt, out of which, with diſtilled vinegar, and its own tartarous ſalt, a tincture, more curious than uſeful, was extracted,

To this he ſubjoins an account of the grand uſe of mercury, in ſeparating ſilver in the *Indies*; that metal being generated, as commonly it is, in certain rocky ſtones, abounding with bituminous and corroſive mixtures, it is impoſſible to free it wholly from its corrupt matrix, by violent melting, whatever auxiliary ingredients may be added, as lead and artificial ſalts, becauſe, theſe ſulphurous and vitriolic compounds, melting together with the ſilver, ſublime part of it away in a volatile fume by their corroding acrimony, and calcine and vitrify what remains; in this caſe, the uſe of quickſilver is found very advantageous, which is briefly as follows: Having reduced the ore into ſmall parts, they calcine it firſt in a reverberatory furnace, and with a moderate fire, for fear of fuſion; this calcination ſerves chiefly to free the mineral from what may hinder the operation of the mercury; and by the colour of the fumes is diſcovered, what corroſive mixtures it chiefly contains, beſides, that it is made more tractable under the mill-ſtone, in order to reduce it to a ſmall flour, before the application of the mercury; and this is chiefly uſed in thoſe ſilver veins, that are hard and dry; for ſuch as are ſofter, and abounding in oleaginous ſulphurs, before burning, are firſt ground into powder, in ſuch mills, as are often ſeen in glaſs-houſes; and then they receive a gentle calcination, mixing ingredients ſuitable to the peccant humour, ſo to ſpeak of the ore; as ſuppoſe the metal ſulphurous and antimonial, ruſt and droſs of iron are found very proper; if abounding in iron, then ſulphur and antimony, reduced to powder, may be uſed to good purpoſe; ſulphur has a particular force in ſoftening and diſſolving iron: After the ore is ground, calcined and ſifted, it is divided into ſeveral heaps, and then by leſſer eſſays, they find what quantity of ſilver each heap contains; the ordinary, being 6 ounces to 100 pounds, ſometimes 12, and if it yield 18, it is eſteemed a very rich vein; yet, ſometimes great maſſes of pure ſilver are found, called virgin metal. Having diſcovered the quantity of ſilver in each heap, they proportionably ſprinkle them with mercury, at ſeveral times, ſtirring the ore often about, to make it incorporate with the quickſilver; when, by the colour of the mercury, coagulated by the ſilver in clear large maſſes; they

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conjecture the mercury has done its office in separating all the silver, their knowledge in this case being only conjectural; they wash it by means of three vessels, standing in order, one under the other; so that the matter in the first and highest vessel being washed and stirred about, all the dust of the heterogeneous minerals, that do not incorporate with the mercury, falls with the water into the other vessels, and is thence thrown out by the continual current of the water; and the silver in the mean time is by the weight of the mercury, driven down to the bottom of the vessels or tubs, in clotted lumps, called *Pella's*: After this, the mercury, together with the silver, is taken out of the vessels, and squeezed in coarse and strong linnen, and beat with a beetle; the mercury is, as far as possible, separated from the silver; and this mass is afterwards reduced into a pyramidal or conical figure; in molds of the shape of *Indian* pine-apples, called *Pineas de Plata*, and thus fashioned, for the easier ranging them about the ridges of a great earthen vessel, like a blind alembic, round whose top, a fire being made; the rest of the mercury is immediately separated from the silver, and falls to the bottom. The silver is melted down with the *Liga*, as it is called, allowed by the king of *Spain*; and by which he returns to the people in copper that fifth part, they allow him of all the silver.

He concludes with his thoughts on the transmutation of metals, and is of opinion, that that change is erroneously apprehended by many, who imagine that the whole imperfect metal is totally transformed into the more perfect, by the substance mixed with it; whereas, the mixture, added to the melted metal, unites itself, as he thinks, to those parts, which being homogeneal, symbolize with the nature of the more perfect; whereby the pure metalline parts are separated from the other heterogeneous impure sulphurs, which, together with other causes, hindred nature from concocting that substance into the perfecter metal in the mine.

Observations in Jamaica; *by Mr.* Norwood, Jun. Phil. Trans. N° 41. p. 824.

ALligators are shaped, and walk like lizards, being four-footed; those of a full growth, have teeth like a mastiff, and a mouth a foot and a half wide; they smell so strong, that it is felt at a great distance; in order to kill them, a man must be armed with a good long truncheon, and fall upon them sidewise; for if they are attack'd in front, they are too nimble for the assailant, and may leap upon him, which they can do the length of their whole body; but if they are maimed on the

ſhoulder, and behind their fore-feet; they are then eaſily maſtered.

Tortoiſes die, if their blood be heated, which muſt not be hotter than the element they live in. The *Chegos* are not felt till a week after they are got into the body; they breed in great numbers, and incloſe themſelves in a bag, which when obſerved, there are certain ſkilful perſons, who with little pain take them out; and they take care to extract entirely the whole bag, that none of the brood, which are like nits, may be left behind.

The ſhining flies are a ſpecies of *Cantharides*, appearing green in the day-time, but glowing and ſhining in the night, even in death; and Mr. *Norwood* could, by applying them dead, read a printed or written paper in the dark.

The *Manchinel-apple* is the moſt beautiful fruit to the eye, the moſt agreeable to the ſmell, and the pleaſanteſt to the taſte of any fruit in the world, and therefore called the *Eve-apple*; but if eaten, it is certain death; the wood of it, while green, if rubbed againſt the hand, will fetch off the ſkin, or raiſe bliſters; and if drops of rain, falling from this tree, light on one's hand, or other part of the body, it will have the ſame effect.

A new and univerſal Method, for working Convex-ſpherical Glaſſes *on a* Plane; *by* S. Mancini. Phil. Tranſ. N° 42. p. 837.

TO give a ſpherical figure to a plane, by moving one plane upon another with a circular motion, proceed in this manner: Let the piece, to which the glaſs to be wrought is faſtened, be fitted in the head of a pole, to be of a length, the ſemi-diameter of the ſphere that the lens requires; and, on the ſtool or form, where you intend to work, let there be put a plane of iron or other metal, horizontally, and let the pole be faſtened to the cieling of the room, perpendicularly over this plane, or lower, if need be, after this manner; about the head of the pole, faſten a frame, made of two concentric rings or hoops, ſo that the one move within the other on two poles; and this other, on other poles, moveable between two ſmall arms fix'd to the cieling; or the ſame may be done with a moveable ball within two fix'd circles, and faſtened on the top of the pole: Which is plain from the figures, for (in Fig. 1. Plate V.) T is the lens, cemented to the piece E, faſtened to the pole S, paſſing thro' the center of the inner circle B (Fig. 2.), moving upon the pivots I H in the outer circle A; and this is faſtened in a frame on the pivots L M, in the arms C D (Fig. 1.), fix'd in a wall, or above in the cieling, as was ſaid; and above this frame, let a pin be put thro' the upper

upper pole, to hinder its getting out of the circle B, and to be raiſed a little, but not to be made lower by the workman, or elſe; let the pole S (fig. 3.) be thruſt into the moveable ball ON, within the two circles P, Q, fixt to the two arms Z Z and let the two circles be parallel, preventing the balls getting out; but one larger circle, about the middle of the ball, in the manner of a ſocket, may ſupply the place of the two; it is enough if the ball do but freely move in it, yet ſo as always to touch it, to keep its centre, when it moves, in the ſame ſituation: Let the plain F (fig. 1.) of the iron or other metal, on which the glaſs is to be ground, be placed level on the form G, to do which, the following contrivance is proper; prepare two ſquare planks of wood F R equally thick, long and broad; but in the undermoſt fix a ſquare ruler, ſolid and firm, and as long as is the thickneſs of both the planks, and in the upper plank make a ſquare hole or groove, that the plank may ſteadily ſlide on that ruler, and put a ledge on it to keep the board more firm and ſtiff upon it: Further, let the two planks have two gutters, R, U, going a-croſs from one end to the other; into which two wooden wedges may paſs like Y, four of which are to be put againſt each other in the ſaid gutters; and then placing the plate F T level on the planks F R, take a pendulum, or other levelling inſtrument, and fit it to the ſaid plate, and adjuſt its level poſition by the wedges.

The uſe of this inſtrument is very eaſy, ſince it is ſufficient to guide the turn-tool with your hands, faſtned to the pole upon the plane, where the ſand is ſpread; and continuing to turn it, till the glaſs has taken its ſpherical figure; it may be poliſhed on the ſame plane, applying to it the cemented paper; but it muſt be obſerved, that the poliſhing by this inſtrument is very tedious; ſo that it is adviſeable, after the glaſs is wrought to its perfect figure, to uſe certain gutters proportionable to the ſphere, whoſe ſemidiameter is repreſented by the length of the pole above mentioned; and the ſame rules to be obſerved as in grinding convex glaſſes; the gutters are thus deſcribed, a poliſher muſt be made in the form of a gutter, excavated its whole length, and which may alſo be hollowed ſpherical by a wooden mould, turned of a ſpherical figure by a gage, fixt on a mandril, and made to turn round.

Tho' this contrivance be ingenious enough, yet ſkillful artiſts are of opinion, that it will be hard to practice it on glaſſes of any conſiderable length.

N. B. This is a tranſlation from the *Latin.*

Trans-

Transfusing Blood *into the Veins of an old* Spaniel. Phil. Tranf. N° 42. p. 481.

A Spaniel of a middle fize, 13 years old, and that had been deaf for three years to fuch a degree as not to hear the greateft noife; fo feeble, that he could not lift up his feet, only trailing his body along; upon transfufing the blood of a lamb into his veins, and continuing untied on the table for an hour, he afterwards leapt down, and went to find his mafter, who was in another room; two days after he went abroad, and ran up and down the ftreets with other dogs; his ftomach returned, and he began to eat more greedily than before, and from that time gave figns that he began to hear, till at laft he wholly recovered that fenfe.

A Defcription of a new Microfcope; *by* Euftachio Divini. Phil. Tranf. N° 42. p. 842.

E. *Divini* has made a microfcope of a new invention, wherein, inftead of an eye-glafs convex on each fide, there are two plano-covex glaffes, fo placed as to touch one another in the middle of their convexity; this inftrument is peculiar in this, that it fhews the objects flat and not crooked, and tho' it takes in much, yet magnifies extraordinarily; it is almoft 16 $\frac{1}{2}$ inches high, and adjufted at four different lengths; in the firft, which is the leaft, it fhews lines, 41 times bigger than they appear to the naked eye; in the fecond, 90 times; in the third 111 times; and in the fourth, 143 times; whence may be eafily calculated, how much it magnifies furfaces and folidities: The diameter of the field, or the fubtufe of the vifual angle meafured on the object-plate, in the firft length, is 8 inches, 7 lines; in the fecond, 12 inches, 4 lines; in the third, 13 inches; and in the fourth, a little more than 16 inches; on viewing with this microfcope fmall grains of fearced fand, they perceived an animal of many feet, its back white and fcaly, but lefs than any hitherto obferved; for, tho' the microfcope fhewed every grain of feed, as big as an ordinary nut, yet this animal appeared no bigger than one of the grains feen without a microfcope.

Of the Tefticles; *by* Vadlius Dalhirius Bonglarus, *tranflated from the Latin.* Phil. Tranf. N° 42. p. 843.

THIS author obferving the oppofite and contradictory accounts given of the ftructure of the tefticles by anatomifts, applied himfelf with the greater nicety and attention to diffect

diſſect them, and he has accordingly repreſented his obſervations upon them in two figures: Fig. 4. is the teſticle of a man, and fig. 5. that of a boar: A A are the two teſticles cut thro' the middle, B B the *tunica albuginea*, C the inſertion of the *vaſa præparantia* into the *albuginea*, D D, *Highmore*'s *duct* running exactly thro' the middle of the *teſtes* of a boar, but different from that of a man; it may be doubted whether *Riolanſus*'s *linea fibroſa* be inſeparable from the coat of the *teſtes* or not; E E E E the *vaſa præparantia*, perforating the *albuginea*, and connected with the *ductus*; F F F F the genuine ſubſtance of the teſticle of a man, not glandulous but entirely vaſcular; ſo that the whole teſticle conſtitutes only one veſſel, between the veſſels of the *teſtes* in a boar lies a ſmooth *ſtratum* or layer of fleſh f f f f; G G G G are ſmall pipes, or tubes, whoſe number is precarious, ariſing from the *ductus*, immediately at its origin from the *albuginea* in the head of the *teſtes*; H H the beginning of the *epididymus*, not glandulous according to *Highmore*, but vaſcular according to *Riolanus*, which veſſels are connected together by a ſtrong membrane; whence it appears that the *epididymus* ariſes from the ſmall pipes, and theſe again from the *ductus*; ſo that the ſeed is at firſt ſecreted in the veſſels of the *teſtes*, from which it flows into the *ductus*, and from that again it is conveyed to the *epididymus*, in whoſe windings it is elaborated and brought to perfection; I I the remaining part of the *epididymus*, which is entirely vaſcular, ſo that in the teſticle and *epididymus* of a man there are no glands to be found; K K the ejaculatory veſſel, which is a continuation of the *epididymus*.

This ſubject has ſince been examined with ſo much care and exactneſs, that it now plainly appears, the teſticles are only a congeries or number of very fine veſſels, that may be drawn out like thread from a bottom.

Obſervations and Experiments on Vegetation and the running of Sap; *by Dr.* J. Beal *and Dr.* Tonge. Phil. Tranſ. N° 43. p. 853.

SEveral vegetables, as elders, briars, ſallows, willows, the black elder, vines, and moſt ſhrubs, as alſo current trees, and ſuch as are of a ſoft wood and quick growth, will grow with the wrong end planted in the earth; two or three of their joints being covered in the mould, and the ſtem cut off near the uppermoſt joint, which ſhould be half covered in the mould, and the mould ſomewhat raiſed, as it grows.

A branch,

A branch, whilſt yet growing on the tree, being laid in the ground, and there taking root, will grow at both ends, if it be well rooted, and the like care taken of the laſt joint, as above; and the layers of the trees, mentioned in the former obſervation, will grow at both ends, and aptly ſeparated, when they have ſpread roots both ways, make two plants out of each layer.

In the tapping of trees, it is obſerved that the juice aſcends from the root, and after concoction in the plant deſcends to the orifice whence it iſſues; *Ratray*, the learned *Scot*, affirms that he had calculated experimentally, that the liquor the birch yields in the ſpring equiponderates the whole weight of the tree, both branches and root.

Dr. *Tonge* is of opinion, that ſap always riſes and never properly deſcends, having only a kind of ſubſiding, which, he ſays, he cannot call a circulation; and he explains it thus; that the ſap neceſſary to the growth of the leaves, fruit and upper branches, being diſpenſed in ſuch manner that the ſap in the innermoſt coats feeds the internal, and that of the outward, the external parts of fruits, *&c.* the remaining juice between the ſeveral coats and between the bark and body, begins to condenſe firſt into a jelly, and after into wood, bark, roots, *&c.* according as it ſubſides; and becauſe it condenſes faſter in ſome parts than others, the ſap condenſed higher or lower, takes leſs room, and muſt needs cauſe the ſap, which is not yet condenſed, in appearance only to deſcend or ſubſide: The trees obſerved to run are the vine; the birch plentifully at body, branches and roots; the walnut-tree, at the roots, and pruned branches; ſome willows and ſallows, and ſome ſorts of maples, the ſycamore, which is the greater maple, at a gaſh in the bark of the trunk, and at the root and branches: The whiting or quicking-tree, called in Latin, *fraxinus ſilveſtris*, and by ſome *fraxinus cambrobritanica*, is affirmed by ſome to run plentifully, and its juice to be a ſovereign drink in ſcorbutic and ſplenetic caſes; Dr. *Tonge* kept ſome of the juice of the berries for two years in bottles, and it had the taſte of an auſtere cyder: It is the common drink in *Wales* and *Herefordſhire*; and ſome out of curioſity brewed ripe berries with ſtrong beer and ale, and kept it ſo long that it exceeded any beer in goodneſs. His attempts upon the poplar, aſp, elm, oak, aſh, elder, whiting-berry or quicking-tree, thorn, buckthorn, tile, nut, ſloe, briar, bramble, *&c.* ſucceeded not, becauſe, he thinks that their juice, as alſo that of apples and pears has ſome degree of gummineſs, that hinders their running.

The

The ſap riſes by the internal bark, where the quick begins, and the graft firſt incorporates.

There are circles obſerved in trees, which are the diſtances of the films and coats, by which they receive their yearly increaſe in thickneſs; thro' theſe, appearing full of circular pores, the ſap ſeems to aſcend, in the ſame manner between one coat and the other, as between the bark and the body.

Bark is twofold, external and internal, the former is dry and in ſome trees rough, the latter, probably, a ſuperadded coat of a years growth: the ſap riſes both on the inſide and outſide thereof.

If you cut round any common tree, of *Engliſh* growth, to the ſolid timber with a knife never ſo thin, the tree will die from that part upwards, except the aſh.

In order to get the gum of plumb-trees, twiſt the branch, till the timber crack, and the rind break in ſome parts, and leaving it to grow in that wreathed poſture, next ſummer it will yield a great deal of gum.

Tho' you take off the breadth of two or three inches, of bark quite round towards the root of ſome trees and particularly, the lime-tree, it will live and bear leaves for many years, by means of the ſap aſcending thro' the pores of the internal coats.

Piths are of a very different nature and ſubſtance; in the walnut, it is a number of films manifeſtly diſtant from each other; in elders and briars, it is a continued, ſoft, looſe, dry ſubſtance.

The extremities of roots, on cutting them off, will in proportion bleed as plentifully, as the branches, and probably more, but certainly longer, becauſe there is greater plenty of juice aſcended above them, than above the branches, and conſequently a greater flux of juice by them, than by any part of the tree higher than they.

Trees will bleed from the latter end of *January* to the middle of *May*; the poplar, aſp, abele, maple, ſycamore are ſaid to run firſt; willows and the birch are beſt to tap about the middle of the ſecond ſeaſon, and the walnut towards the latter end of *March*; they generally bleed a full month in the whole. Mr. *Midford* of *Durham* affirms that the ſaps of the poplar and aſp riſe ſo briſkly in *January*, that they will bleed before the end of that month; the ſycamore will run in hard froſt, the ſap freezing as it drops.

The best time of the day for tapping, is about noon; in the latter season, when sap is not very plentiful in trees, they will neither run morning or evening, nor probably at any time of the night; but when very full of sap and emptied but by small vents, the sap may run night and day, till exhausted, but never in large vents: And this observation may give light to that opinion, which holds, that the ascent of the sap depends on the pressure or pulsion of heat, striking the earth, and thereby driving the moisture of the earth into the root.

Trees afford no juice at all, as far as has been observed, in autumn.

The quantity of sap depends on the quantity of rain.

Observations in the East-Indies; *by* Sir Phil. Vernatti. Phil. Transf. N° 43. p. 863.

PEARL-divers can hold under water no longer than about a quarter of an hour, and by no other means than custom; pearl fishing does not last above six weeks; divers continue longer under water, at the end of the season, than at the beginning: There is an expert diver at *Batavia* who lives by diving for anchors, guns, *&c.* lost in the road; Sir *Philiberto* himself had held his breath as long as he could, but the diver continued ten times longer under water than he could hold his breath; but you must give him a whole pint of strong water before he plunges.

The extracting the oil from the roots of cinnamon-trees, which resembles camphire, is done by drying, bruising and steeping them in water, and then the oil is drawn over by an alembick.

The *Lignum* aloes is part of a living tree, but commonly found, when it is withered; the tree itself is of a soft white wood, yielding a milky juice, which is so noxious, that if in cutting the tree, any of it should fall into the eye, the person grows blind, and if on any other part of the body, it becomes scabbed, noisome and painful: The *Lignum* aloes or *Calambac* is found within the white wood, but not every where; when the tree decays, the white wood soon withers, and grows worm eaten, and the milk becomes so hard, that you may rub it between your hands: The best is found in the heart of the rree. The wood smells rank like human excrement, and grows naturally in the islands of *Solor* and *Timor.*

There are serpents in those parts with a head on each extremity of the body, called *Capra capella*; they are looked upon

upon as ſacred, and portend good to thoſe in whoſe houſes and lands they are found, but evil to ſuch as do them harm.

The general Laws of Motion; *by* Dr. Wallis, *tranſlated from the* Latin. Phil. Tranſ. N° 43. p. 864.

1. IF an agent A produce the effect E, 2 A will produce 2 E, 3 A, 3 E, *&c.* And univerſally *m* A will produce the effect *m* E, taking *m* for the exponent of any ratio.

2. Therefore, if the *vis* or power U move the *pondus* or body P, the power *m* U will move the body *m* P, ſuppoſing all other things equal; as for inſtance, the ſame length, and the ſame time, that is, the ſame velocity.

3. If a power move a body in the time T, thro' the length L; in the time *n* T, it will move it thro' the length or ſpace *n* L.

4. Therefore, if the power U in the time T move the body P, thro' the length L; the power *m* U, in the time *n* T, will move the body *m* P, thro' the length *n* L; and conſequently, as U T, the product of the power and time, is to P L, the product of the weight and length ſo is *m n* U T to *m n* P L.

5. Becauſe the degrees of velocity are proportional to the lengths run over in the ſame time, or, which is the ſame thing, reciprocally proportional to the times taken up in running over that length; $\frac{L}{T} : C :: \frac{mL}{nT} : \frac{m}{n} C$; that is, the degrees of celerity are compounded of the direct ratio of the lengths and the reciprocal ratio of the times.

6. Conſequently, becauſe $UT : PL :: mnUT : mnPL$. U will be to $\frac{PL}{T} :: mU : \frac{mnPL}{nT}$, that is, $U : PC :: mU : mPC = mP \times C = P \times mC$.

7. That is, if rhe power U can move the body P with the celerity C : the power *m* U will either move the ſame body P, with the celerity *m* C; or the body *m* P, with the ſame celerity C; or in fine, any body with ſuch a velocity, that the product of the quantity of matter and velocity be *m* P C.

8. And on this principle depends the conſtruction of all machines for facilitating motions; *viz.* that in what ratio ſoever the quantity of matter be augmented, in the very ſame, the velocity muſt be leſſened; whereby the product ariſing from celerity and quantity of matter to be moved by the ſame force, may ſtill be the ſame; ſuppoſe $U : PC :: U : mP \times \frac{1}{m} C = PC$.

 9. If

9. If the body P, moved by the power U, and with the celerity C, impinge directly against a quiescent body m P, (not hindred) they will both move with the celerity $\frac{1}{1+m}$ C; for, because the power applied for moving the greater weight is the same, the celerity of the other will be diminished in the same ratio: $U : PC :: U : \frac{1+m}{1} P \times \frac{1}{1+m} C = PC$ consequently the impetus or momentum of the one, that is, the product arising from the quantity of matter into the velocity will be $\frac{1}{1+m}$ PC and of the other $\frac{1}{1+m} m$ PC.

10. If a body, following another with a greater velocity, directly impinge upon it, as for instance m P, with the celerity n C, and consequently moved by the power mn U, on the body P, moved with the celerity C and power U; they will both be moved with the celerity $\frac{1+mn}{1+m}$ C; for $U : PC :: mnU : mnPC :: U + mnU = \frac{1+mn}{1} U : \frac{1+mn}{1} PC = \frac{1+m}{1} P \times \frac{1+mn}{1+m} C$: consequently the impetus or momentum of the preceeding body will be $\frac{1+mn}{1+m}$ PC; and that of the following body, $\frac{1+mn}{1+m} m$ PC.

11. If bodies moving contrary ways impinge directly against each other, as for instance, the body P moved by the power U and celerity C towards the right hand, and the body m P, with the celerity n C towards the left, and consequently, by the power mn U; the celerity, impetus, and direction of both are thus found; the body moved towards the right, would impart the celerity $\frac{1}{1+m}$ C and consequently the impetus $\frac{1}{1+m} m$ P C towards the same hand, to the other, supposed at rest, and itself would retain that same celerity, and consequently the momentum $\frac{1}{1+m}$ P C towards the right hand (by 9.): And after the same manner a body moved towards the left hand, would communicate the celerity $\frac{mn}{1+m}$ C and consequently the

the impetus $\frac{mn}{1+m}$ m P C towards the left hand to the other ſuppos'd at reſt, and itſelf would have that ſame celerity, and conſequently the impetus $\frac{mn}{1+m}$ P C towards the left hand; when therefore the motions are contrary, the impetus of the body that firſt moved towards the right hand, will now be an aggregate of the impetus $\frac{1}{1+m}$ P C towards the right hand and $\frac{mn}{1+m}$ P C towards the left; and conſequently, the motion will in reality be made either towards the right or left, as the one happens to exceed the other, and with an impetus, equal the difference of their impetus or momenta; that is, putting the ſign $+$ for the right hand, and $-$ for the left; the impetus will be $+\frac{1}{1+m}$ P C $-\frac{mn}{1+m}$ P C $=\frac{1-mn}{1+m}$ P C; the celerity $\frac{1-mn}{1+m}$C; conſequently towards either right or left, as either 1 or mn is greater: After the ſame manner, the impetus of the firſt will be $+\frac{1}{1+m}m$ P C $-\frac{mn}{1+m}m$ P C $=\frac{1-mn}{1+m}m$ P C; and the celerity $\frac{1-mn}{1+m}$ C; and conſequently to the right or left as 1 or mn happen to be greater.

12. If the bodies ſhould neither proceed directly in the ſame direction, nor in contrary directions, but impinge obliquely; the preceeding calculus is to be regulated according to that obliquity; and the impetus of a body impinging obliquely to that of its direct impulſe, *cæteris paribus*, is as the radius to the ſecant of the angle of obliquity, and the ſame ratio holds in the oblique deſcent of heavy bodies to their perpendicular deſcent.

13. If we ſuppoſe the impinging bodies not abſolutely hard but elaſtic, in that caſe, bodies, that might otherwiſe move on together, will recede from each other, and that in proportion to the elaſticity; *viz.* if the elaſtic impetus exceed the progreſſive.

In accelerated and retarded motions, the impetus for every moment of time is that which anſwers to the acquired degree of velocity in each of theſe moments; if the motion be in a curve, the direction thereof in each point of the curve is the ſame

ſame with the direction of the tangent to that point; and if an accelerated or retarded motion be made in a curve, as in the vibrations of a pendulum, the impetus is to be eſtimated for each point, both by the degree of acceleration, and the obliquity of the tangent to that point.

The Law of the Colliſion *of* Bodies; *by Sir* Chriſt. Wren. Phil. Tranſ. N° 43. p. 867. Tranſlated from the *Latin*.

THE proper and moſt natural velocities of bodies, are reciprocally proportional to theſe bodies; therefore the bodies R and S, having proper velocities, do after impulſe retain them; and the bodies R and S, having improper velocities, are brought to an equilibrium by the impulſe; that is, as much as R exceeds, and S wants of the proper velocity before the impulſe; ſo much R loſes of its impulſe, and S gains, and on the contrary: Wherefore, the colliſion of bodies with proper velocities is equipollent to a balance ſwinging on its centre of gravity; and the colliſion of bodies, with improper velocities, to a balance ſwinging on two centres, equally diſtant from the centre of gravity: There are therefore three caſes of equal bodies, and ten of unequal, with improper velocities, five of which laſt are by converſion, whether in the ſame or contrary directions.

R, S (Fig. 1. Plate VI.) are equal bodies, or R is greater and S leſs, *a*, the centre of gravity, or handle of the balance, Z, the ſum of the velocities of both bodies.

$$\left.\begin{array}{l}\begin{array}{c}R\,e\\S\,e\end{array}\left\}\begin{array}{c}\text{velocit.}\\\text{of the}\\\text{bodies}\end{array}\right\}\begin{array}{c}R\\S\end{array}\left\}\begin{array}{c}\text{given}\\\text{before}\\\text{impul.}\end{array}\right.\\[1em]\begin{array}{c}o\,R\\o\,S\end{array}\left\}\begin{array}{c}\text{velocit.}\\\text{of the}\\\text{bodies}\end{array}\right\}\begin{array}{c}R\\S\end{array}\left\}\begin{array}{c}\text{ſought}\\\text{after}\\\text{impul.}\end{array}\right.\end{array}\right\}\text{Or,}\left\{\begin{array}{l}\begin{array}{c}S\,o\\R\,o\end{array}\left\{\begin{array}{c}\text{velocit.}\\\text{of the}\\\text{bodies}\end{array}\right\}\begin{array}{c}S\\R\end{array}\left\{\begin{array}{c}\text{given}\\\text{before}\\\text{impul.}\end{array}\right\}\\[1em]\begin{array}{c}e\,S\\e\,R\end{array}\left\{\begin{array}{c}\text{velocit.}\\\text{of the}\\\text{bodies}\end{array}\right\}\begin{array}{c}S\\R\end{array}\left\{\begin{array}{c}\text{ſought}\\\text{after}\\\text{impul.}\end{array}\right\}\end{array}\right.$$

Rule. R*e*, S*e*, make *o*R, *o*S: R*o*, S*o*, make *e*S, *e*R.

Read the ſyllables, tho' disjoined, R*e*, S*e*, *o*R, *o*S, or R*o*, S*o*, *e*S, *e*R, in the line or figure of each caſe; and thoſe read from right to left in the ſcheme, indicate a motion contrary to thoſe read from left to right. A ſyllable conjoined, denotes a ſtate of reſt of the body.

$$\text{The Calculus}\ \begin{array}{l|l|l} R+S:S::Z:Ra & Re-2Ra=oR & So-2Sa=eS \\ R+S:R::Z:Sa & 2Sa+Se=oS & 2Ra+Ro=eR \end{array}$$

Nature obſerves the rules of ſpecious addition and ſubtraction.

Obſer-

Obſervations on Vegetables; *by Dr.* Tonge. Phil. Tranſ. N° 44. p. 877.

IF the roots of trees have no rain, or other moiſture, they will not grow; but if the points of the roots only be watered, and all the reſt remain dry, as it naturally happens in fir-trees, they may grow very well; for the points of the roots ſhoot out yearly a ſharp-pointed tender part, ſomewhat like the ſharp bud on the end of a ſprig, by which the root not only enlarges itſelf in the earth, as the branch does in the air, but alſo receives its nouriſhment; and that tender part moves towards the beſt moiſtened, and the tendereſt earth; ſo that to promote the growth of trees, the looſening the earth about the points of the roots is very effectual.

Inoculating on the roots of plumb and lime-trees, will make their buds ſhoot; let the root be bared in the fall of the leaf, and taken out of the earth; and at a convenient diſtance from the body of the tree, bend and raiſe it a foot above the earth, and then laying the points and fibres of the root carefully about with freſh mould, and watering them till they take well, and till the root, raiſed in the air, have a bark like that of a branch of a tree; the inoculation is made on the raiſed part, after the ordinary manner; and when it is done, let it be carefully covered with ſoft wax, to defend it from the rain.

The arms of the roots of trees, are to be cut for the advantage of their growth, according to the proportion they have to their head and body; or according to your deſign of encreaſing wood or fruit; for the external roots feed the wood, and the internal, the fruit.

The depth at which trees are ſet, ſhould never be below the reach of the ſun's heat, nor the goodneſs of the mould, and rather ſhallow than deep, in regard, they are more inclinable to ſink, than raiſe themſelves, if they be out of the reach of the ſun's heat, the cauſe of pulſion and nouriſhment.

The ſeeds of fir, pine, *&c.* will either not grow at all, or with difficulty, if the blunt end be put downwards; becauſe in that poſition it muſt turn itſelf, before it can emerge into the air, for the root is ſhot downwards at the ſharp end; but it may grow very well, if ſet horizontally.

Some young plants, if their heads be kept moiſt, will live all winter, if it be mild, tho' their roots be in the air; as was obſerved in ſeedlings of apples and crabs; their roots, ſet afterwards in the ſpring, grew and lived. The reaſon, why ſome plants

grow in ſticks, may be owing to the ſoftneſs of ſuch wood, whereby they are more ſuſceptible of receiving nouriſhment like roots, and to ſhoot out roots and fibres from themſelves; but in ſlips taken from a firmer wood, a moiſt temperate ſeaſon is to be obſerved, and a ſtone, or chip of wood to be cloſed to the end of the ſlip, and ſet in the earth with it; which helps its rooting.

The ſap of a large walnut, in the latter ſeaſon of its running, that is, when it yields no longer any ſap, either in the body or branches, at any time of the day, runs longer at the roots on the ſouth or ſunny ſide, than on the north or ſhady ſide.

Plenty of rain can cauſe no greater plenty of ſap, than the pores of the root, body, and branches will receive and digeſt; ſo that it ſeems probable, that drawing ſap every year from trees, will not hinder their growth in body, branches, leaves, or fruit; for pulſion will ſtill ſupply juice into the emptied pores, till their capacity be filled.

It is alſo poſſible, that trees may grow better, and give more fruit, if the right art of tapping were found out, as ſome perſons fatten by often drawing blood; and it ſeems probable, that tapping will only hinder the growth of fruit, leaves, or uppermoſt ſhoots in tops of trees, and yearly ſhoots in extreme parts; and hence appears the reaſon of ſuckers robbing fruit, becauſe, till the whole tree be filled with ſap, the fruit, in the outmoſt branches, cannot be ſerved; wherefore, not only ſuckers, but all ſuperfluous not-bearing branches are to be lop'd in the beginning of ſpring.

An Anatomical Account of Tho. Parre; *by Dr.* Harvey. Phil. Tranſ. N° 44. p. 886.

THomas *Parre* was a poor countryman of *Shropſhire*, whence he was brought up to *London* by *Thomas*, earl of *Arundel* and *Surrey*, and died at the age of 152 years 9 months, after ſurviving nine princes. *Nov.* 16th, 1635, being opened after his death, his body was ſtill found very fleſhy; his breaſt hairy; his genitals unimpaired, and they ſerved to confirm the report of his having undergone public cenſures for his incontinency; at the age of 120, he married a widow, who owned he acted the part of a man, and that for twelve years after: He had a large breaſt, lungs not fungous, but ſticking to his ribs, and diſtended with much blood; his face livid, having had a difficulty of breathing a little before his death, and a laſting warmth in his arm-pits, and breaſt, after it; his heart was great, thick, fibrous, and fat; the blood in the heart blackiſh and diluted; the cartilages of the

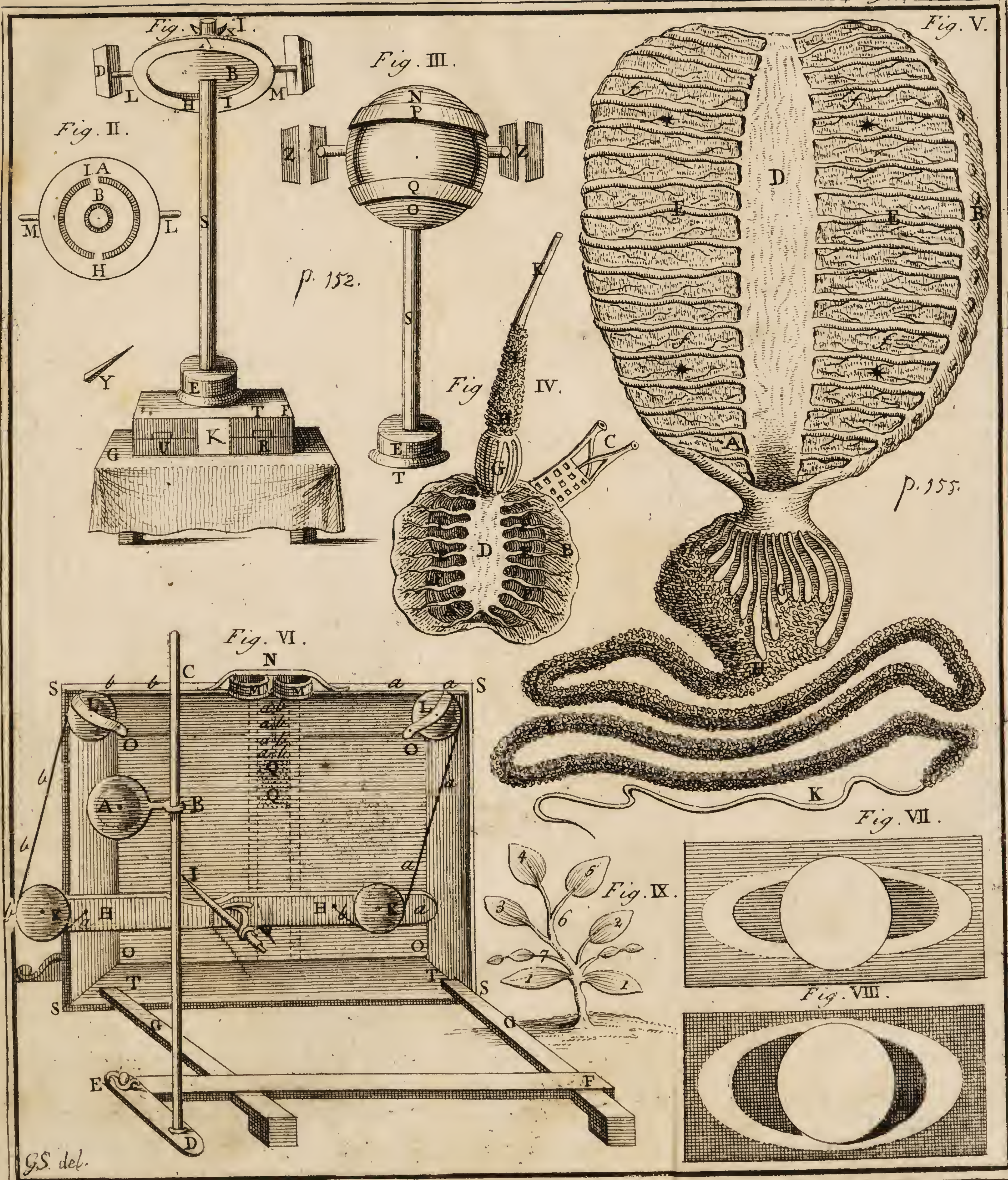

Fig. I.
Fig. II.
Fig. III.
Fig. IV.
Fig. V.
Fig. VI.
Fig. VII.
Fig. VIII.
Fig. IX.
p. 152.
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G.S. del.
Hulett Sculp

Sternum not more bony than in others, but flexible and ſoft; his *Viſcera* was ſound and ſtrong, eſpecially his ſtomach; and it was obſerved of him, that he uſed to eat often both by night and by day; taking up with old cheeſe, milk, coarſe bread, ſmall beer, and whey; and which is more remarkable, he eat at midnight, a little before he died; his kidneys were covered with fat, and pretty ſound, only in the anterior part were found ſome aqueous abſceſſes, whereof one was as big as a hen's egg, with a yellowiſh water in it: There was not the leaſt appearance of any ſtony matter, either in the kidneys or bladder: His bowels were alſo ſound, a little whitiſh externally; his ſpleen very ſmall, hardly as big as a kidney: In ſhort, all his inward parts appeared ſo ſound, that if he had not changed his diet and air, he might perhaps have lived a great while longer: His brain was entire, and firm; and tho' he had not the uſe of his eyes, nor his memory, ſeveral years before he died, yet he had his hearing and apprehenſion very well, and was able to the 150th year of his age, to do any husbandman's work, even threſhing of corn.

An Inſtrument for drawing the Out-lines *of any* Object *in* Perſpective; *by Sir* Chriſt. Wren. ~~Phil. Tranſ. N° 45. p. 898.~~

A, ~~Fig. 6. Plate V.~~ is a ſmall ſight with a ſhort arm B, which may be turned round, and moved up and down the ſmall cylinder C D, ſcrewed into the piece E D, at D; this piece E D, moving about the centre E, the ſight may be removed either towards R or F; E F is a ruler faſtened on to the two rulers G G, which together ſerve to keep the ſquare frame S S S S perpendicular, and by their ſliding thro' the ſquare holes T T, they ſerve to keep the ſight either at a greater or leſs diſtance from the ſaid frame; the paper O O O O, whereon the picture is to be drawn by the pen I, is ſtuck on the frame with a little wax; this pen I, is by a ſmall braſs handle U, ſo fixed to the ruler H H, that the point I may be kept very firm, ſo as always to touch the paper: H H is a ruler, that is always moved horizontally, or parallel to itſelf, by means of the ſmall ſtrings *aaaabbbb*; at whoſe end is ſtuck a ſmall pin, whoſe head P is the ſight, which is to be moved up and down on the out-lines of any object: The contrivance of the ſtrings is this; the two ſtrings *aaa bbb*, are exactly of an equal length; two ends of them are faſtened into a ſmall leaden weight Q Q, moved in a ſocket on the back-ſide of the frame, ſerving exactly to counterpoiſe the ruler H H, being of equal weight with it; the other two extremities are faſtened to two ſmall pins H H, after paſſing over the ſmall pullies N,

MM, LL, KK; by means of which pullies, if the pen I be taken hold of, and moved up and down the paper, the ſtrings moving very eaſily, the ruler will always remain in a horizontal poſition.

The manner of uſing it is this; ſet the inſtrument on a table, and fix the ſight A at any height above the table, and at any diſtance from the frame SSSS; then looking thro' the ſight A, and holding the pen I in your hand, move the head of the pin P up and down the out-lines of the object, and the point I will deſcribe on the paper OOOO, the ſhape of the object ſo traced.

An Obſervation of Saturn, *at* Paris; *by M.* Huygens *and M.* Picard. Phil. Tranſ. N° 45. p. 900.

AUGUST 17th, 1668, 11 ½ hours at night, theſe obſervers, with a teleſcope of 21 foot, ſaw the planet *Saturn*, as repreſented Fig. 7; the middle of his globe appearing, both above and below, beyond the oval of his *Anſæ*, which was hardly diſcernible laſt year: The inclination of the great diameter of the oval to the equator was meaſured ſeveral ways, and found about 9°, tho' then it ſhould be no more than 4°, according to what *Huygens* had affirmed in his ſyſtem of *Saturn*, *viz.* that the plane of the ring is inclined to that of the ecliptic but 23° 30′: But by this, and other more exact obſervations, M. *Huygens* finds, that, inſtead of 23° 30′, the angle of the planes of the ring and ecliptic muſt be about 31°: And not only the ſhape that *Saturn* has at preſent, but all thoſe that have been remarked, ſince the true ones were obſerved, do perfectly agree with the hypotheſis of the ring; and particularly that of *July*, 1664; made and publiſhed by *S. Campani*, wherein the great diameter is double the leſs. See Fig. 8. Plate V.

The ordering of Melons; *by M.* de la Quintinie. Phil. Tranſ. N° 45. p. 901.

THE firſt thing appearing in melons are two united leaves or ears (Fig. 9.) marked 1 1; between theſe two ears ſhoots ſome days after, firſt, a leaf, called the firſt leaf or knot, 2; and out of the ſame part, in a few days more, a ſecond, called the ſecond knot, 3; from the middle of the ſtalk of this ſecond knot, ſhoots the third knot, 4; and this third, muſt be cut at the place 6, without hurting the branch of the ſecond knot, whence it ſhooted; becauſe from that place, will ſpring a branch, called the firſt arm, which will ſend forth, firſt, one knot, then, a ſecond, and then, a third; and this third you are to cut in the ſame manner, as was ſaid above; and theſe third knots muſt be cut before

before the ſhooting of the fourth or fifth; and out of every knot, proceed arms or branches like to the firſt; and at theſe arms the melons are produced; which will prove good, if the root be well nouriſhed in good earth, and cheriſhed by a good hot bed, and the ſun; but let the foot of the melon never paſs into the dung, and let the earth be watered moderately; when you obſerve it grow too dry, leaſt the ſhoot ſuffer thereby, M. *de la Quintinie* watered twice or thrice a week in very hot weather, and about ſun-ſet; and he covered his melons with a ſtraw-mat, from eleven in the forenoon to two in the afternoon, when the heat of the ſun is too violent and too quickly conſuming that little moiſture, which is neceſſary for the root: And when it rained, he covered his melon garden, that too much wet might not hurt his fruit. If the root produce too many branches or arms, cut away the weakeſt, and leave only three or four of the ſtrongeſt and moſt vigorous, and ſuch as have their knots neareſt each other. When he tranſplanted his melons from the nurſery-bed, he commonly put two roots together, except he found one very ſtrong, and that he planted ſingly, cutting from it neither of the branches ſhooting from each ſide, 7 7; but when he joined two roots together, he quite cut away both the branches, that ſhoot from the two leaves. The melons being knit, he leaves but two of them on each foot, chuſing thoſe that are beſt placed, and next to the firſt and principal ſtalk, that is, to the heart of the foot; and he leaves none but fair ones, and ſuch as have a ſhort and thick tail; the foot alſo of the melon muſt be ſhort, well truſſed, and not far diſtant from the ground: Melons of a long ſtem, with the ſtalk of the leaf too long and ſlender, are never vigorous and never yield good melons: Sometimes it happens, that at the very firſt, there ſhoot out between the two ears, two leaves, but this rarely happens; and when it does, ſuch leaves muſt be reckoned but for one knot; and afterwards, there will ſhoot out a ſecond, then a third, &c. and ſo to 25 or 30, if you cut not in time; and it is at the extremity of thoſe diſtant branches, that melons will grow; but they cannot be good, becauſe they are ſo far from the place, which affords them their nouriſhment, and their juice is altered by the length of its paſſage thro' the branches, and ſpoiled by the ſun; whereas the foot of the melon being ſhort, and well truſſed, there are always leaves covering the branches, and even the melons themſelves, till they be near ripe: Too great heat parches them too much, and this muſt be guarded againſt; he that is curious, muſt every day walk in his melon garden, to cut off all the uſeleſs and hurtful branches: Between the two ears

 there

there shoots out one branch more, which ought to be saved, if vigorous, but cut, if weak.

Observations on Vegetables; *by Dr.* Tonge. Phil. Trans. N° 46. p. 913.

IN order to perfect the experiment about sap, and to discover whether it ascends in greater or less quantities in the prick'd circles of the body, than in those between the body and bark; first, let the tree be pierced with an auger, only thro' the bark, and the quantity of sap it yields in an hour, be exactly measured and weighed; then, at the same time, let another hole be bored into the body of the tree, above an inch and a half deep, and so round about on every side of the tree, some deeper, and some shallower, with a good large auger; and one quite thro', sloping: From this experiment may be found the difference of the sap, rising on the north and south side, and likewise of that which comes from the bark only, and that which ascends in the more internal part of the tree; and the weight of that which issues from the bark, may be compared with that which issues from the body: The heart sap may also be drawn apart, by boring a smaller auger-hole in the middle of a greater, and fitting a long pipe into it.

The doctor was told by a curious person, that the corruption of trees depends not so much on the season of the year, and the plenty or scarcity of sap, as on the time of the moon and wind; and that timber-trees felled, when the wind is westerly, especially at the last quarter of the moon, will prevent their being worm-eaten; and the contrary, when felled in an east-wind, and at any time of the moon: And to obviate this corruption, it is advised, that such timber be thrown into water.

Mr. *Jay*, an ingenious planter, supposes *Midsummer* the fittest time for inoculating, not as he says, because the sap descends; but rather, because, it is then most plentiful, and begins to become a jelly.

To make a barren tree bear again; cherish it with dung in trenches, and pare and renew the extremities of its longest roots, and cut off the outmost and shortest, near the body: Hence it may seem, that ploughing helps fruit trees.

Cross hackings promote fruitfulness, cure the *Phyllomania*, or luxuriancy of leaves, the reason of which seems to be, that outward circles and barks feed the wood, and the inner only reach to the outmost sprigs of the last year, at which the fruit hangs: For, some trees bear only on this years shoot, and some only on

that of the laſt, and poſſibly, ſome again on the third years ſhoot, and ceaſe bearing, when they ſhoot no new ſprigs: Seaſonably baring the roots, called *Ablaqueation*, has probably the ſame effect; becauſe it hinders the nouriſhment, eſpecially, of the outer coats, and of bark, leaves, and ſuckers: As ſome ſuckers or ſhoots lately ſprung in outward coats, rob the fruit of the juice, ſo later roots from the outward parts of the main roots, deprive them likewiſe of their firſt nouriſhment in the earth, and therefore ought to be pruned, as well as ſuckers, every year.

The beſt way of obtaining the greateſt quantity of ſap, in the ſhorteſt time from any tree, is not only, to pierce the bark, or cut the body with a chiſel almoſt to the pith, but quite thro' all the circles and the inner rind itſelf, on both ſides of the pith, leaving only the outmoſt circle, and the bark on the north-eaſt ſide unpierced; and this hole is to be bored ſloping upwards, as large as the biggeſt auger you can get, and that alſo thro' and under a large arm near the ground: And in a little time, the tree will afford ſap enough to brew with; and with ſome of thoſe ſweet juices, one buſhel of malt will make as good ale, as four buſhels with ordinary water: Sycamore yields the beſt, as being very ſweet and wholeſom.

In order to preſerve the ſap in the beſt condition for brewing; what is firſt tapped, muſt be conſtantly expoſed to the ſun in glaſſes, or other fit veſſels, till the whole be obtained, elſe it will ſoon contract an acidity; and while it is thus expoſed, put into it very thin and hard toaſted rye-bread without being burnt, as will ſerve to ferment it; and when it works, take out the bread, and bottle the liquor, and uſe waxed corks: If you bake ſage, or any other medicinal herbs in ſuch thin rye-paſte, till they become very dry, you may expect a very wholeſome drink; if you put a few cloves into every glaſs, into which the ſap runs from the tree, it will keep a twelvemonth: Some propoſe to perfume the bottles with oil of ſulphur.

Spirit of wine ferments the juice of ſome berries, and poſſibly may not only preſerve, but heighten the virtue of ſaps; by pouring a little of it, or ſome oily ſpirit into the bottles.

Some uſe rye toaſt, not put in, but hung over it, in ſuch quantity, and at ſuch a diſtance, as may impart a little warmth and motion to the ſurface of the liquor.

Dr. *Tonge* fermented ſome with ale-barm, which converted his fine birch juice into poor ſmall beer.

Honey will not mix with cyder, tho' boiled therein, to make mead; but in a little time, the cyder lets fall the honey, and it becomes ſimple cyder again.

Some

Some affirm, that a decoction of the tops and leaves of birch in the ſap, will preſerve it from ſouring a whole year; and that any ſort of dried aromatic herbs, as ſage, *&c.* boiled in beer, will keep it as well as hops, ling, heath, broom, or wormwood: And ſome uſed bay leaves in their beer and ale.

Fine light *French* manchet, toaſted, may poſſibly be good for our ſaps.

The Communication of the Parts of the Tree, *with thoſe of the* Fruit; *by Dr.* Beale. Phil. Tranſ. N° 46. p. 919.

THE doctor had an excellent ſummer-apple, containing plenty of very agreeable juice, and of that kind that never grows large; the branches were all curled, and full of knots at every turning; and they are apt to grow, if a good knot be ſet in the ground, as ſoon as it is cut off, eſpecially about *Candlemas*: This tree was hollow, and almoſt all the timber extremely rotten, from the top of the ſtem to the root; and every ſprig, how ſmall ſoever, appeared cork-coloured, and rotten at the heart of the timber: And ſo it was generally all over the roots; yet the tree bore plentifully, with alternate reſts, every ſecond or third year: The fruit had ſcarce any core, the kernels were very ſmall, thin, and empty; nevertheleſs, the branches from the knots grew well enough to repleniſh a nurſery: This ſeems to intimate the correſpondence between the pithy part, heart or timber, and the ſeeds: And to confirm this, a young tree grew like a ſucker, from the only ſound root of the apple-tree: This tree grew ſtraiter than others of the ſame kind uſually do, owing to the ſuckers continuing barren for ſome time, till its ſtem was ſtrong enough to bear the fruit: But what is to the purpoſe, is, that all the fruit of this young tree had full and ſound kernels; and tho' it was the ſame fruit, growing from the root of the ſame tree, yet it ſeemed not ſo tender, delicious, and juicy, as that of the old tree, nor was the tree ſo fruitful: It ſeems, that the ſap in the old tree was leſs diverted, to ſuſtain the life of the timber, which was now conſumed, and conſequently wholly appropriated for the leaf, bloſſom, and pulp of the fruit.

Perforated barberry-roots bore berries, that had no ſtones at all: And in hollowed apple-trees, the kernels will be very thin, mere empty ſkins, and uncapable of growth.

Some trees are leſs fruitful, and altogether barren, by the exceſſive growth and firmneſs of the timber, and they are recovered by croſs deep hackings thro' the bark; they cleave the roots, and put a ſtone into the clefts, that it may not cloſe again too ſoon:

Vines are obſerved to be leſs fruitful, when they are permitted to run out into many woody branches.

To ſhew the affinity between the ſap of the bark, and the pulp of the fruit, he made reſts, in the ſummer time, for water, on the body of *Kentiſh* codlin-trees, and cauſed water to be frequently poured into thoſe cavities; the effect was, that the apples grew to an extraordinary bigneſs, and were very inſipid, and many of them had parts, reſembling very much the pulp of lemons: Some he ſuffered to hang on the tree, and they became full of ſpots of the colour of cork, or like the rottenneſs of an apple.

Further Directions and Obſervations on Melons; *by* M. de la Quintinie. Phil. Tranſ. N° 46. p. 923.

WHEN you have a melon, that comes well knit on a branch, you muſt cut away the reſt of that branch, on this ſide of the fruit, that all the nouriſhment, that would have been diſtributed to the whole branch; may paſs to the fruit at the extremity of that branch, obſerving to cover the fruit with ſome leaves of the other branches, for its better growth under the ſhade, in thoſe parts where it is very hot.

There commonly needs no more than forty days from the time of a melons knitting to that of its maturity.

For keeping of the ſeed, you muſt take no other than ſuch as is found in that part of the melons, which lay towards the ſun: And when you eat the melons, you muſt cleanſe well the ſeeds, and rub them with a linnen cloth; then put them up in ſome convenient place till ſeed-time.

You are not to eat the melons till about 24 hours after gathering; and in the mean time put them in a dry place, neither too hot nor too cold, and free from ſcents good or bad.

Let them be gathered, when neither too ripe nor too green; which you may know by their yellowiſh colour, and by their tail commonly ſplitting, and by their ſmell: A melon ordinarily requires one day from the time of its being ſmitten, or beginning to ſhew its being ripe by a little yellowneſs, to the time of gathering: A melon that ripens too faſt, is never good, which proceeds from the poorneſs or ſickneſs of the foot, which makes it turn thus ſuddenly: The melon muſt be full, without any vacuity, which you may diſcover by knocking on it, and the pulp muſt be dry, only a little dew iſſuing out of it, which ſhould be of a very red colour. Be not ſo ſolicitous for big melons as for good ones; and great melons may be

had, either by ſowing ſeeds of the great kinds, or by much watering others, in which laſt, great care and diſcretion is to be uſed: You may judge of the neceſſity of watering by the vigour required in the foot and leaves, without which the fruit cannot be good for want of proper nouriſhment.

The Laws of Motion; *by* M. Huygens. Tranſlated from the *Latin.* Phil. Tranſ. N° 46. p. 925.

SOME members of the Royal Society, being very earneſt that that important ſubject, the laws of motion, which had been ſeveral times ſtarted among them, but often interrupted, and never ſufficiently diſcuſſed, might at length be brought to a cloſe examination; that illuſtrious body therefore reſolved, that ſuch of their members, as applied themſelves to that argument ſhould be deſired, to produce their thoughts and diſcoveries on that head, and likewiſe to bring into one view what thoſe excellent men, *Galileo*, *Des Cartes*, *Honoratus Fabri*, *Joachimus Jungius*, *Borelli*, and others had invented; that by this means, upon comparing their ſeveral ſentiments on this ſubject, that theory might be adopted, which would be found to agree beſt with obſervations and experiments, carefully made and often repeated.

Upon this, M. *Huygens*, Dr. *Wallis*, and Sir *Chriſtopher Wren*, members of the Society, were animated to finiſh and complete their ſeveral hypotheſes and laws of motion, in forming of which, they had ſpent ſome time: And in a few weeks after, theſe excellent perſons tranſmitted to the Royal Society elegant abſtracts of their theories, deſiring the ſentiments of that illuſtrious body thereon: Dr. *Wallis* was the firſt, who in a letter dated *Nov.* 15th, and read before the Society, the 29th, 1668, had communicated his principles of eſtimating the motion of bodies: Sir *Chriſtopher Wren*, in a little time after, *viz.* 17th of *Dec.* of the ſame year, imparted to the Society, his law of nature about the colliſion of bodies; and the Society ordered, after firſt obtaining the permiſſion of the authors, to publiſh theſe diſcoveries, that they might be more conveniently communicated and more fully diſcuſſed. In the mean time, *viz.* on the 4th of the enſuing *January*, Mr. *Oldenburg* had a letter from M. *Huygens* dated *Jan.* 5. N. S. containing the firſt four rules concerning the motion of bodies after mutual impulſe, together with their demonſtration. And that very day on which Mr. *Oldenburg* received M. *Huygens* letter, he ſent in return a copy of Sir *Chriſt. Wren*'s theory, without opening M. *Huygen*'s, which,

which, on account of its bulk and that gentleman's former promiſes, he ſuſpected to contain ſomething on the ſame argument, till he ſhould have an opportunity of waiting on the honourable lord viſcount *Brounker* preſident of the Society: After which, and on comparing the rules of both, the Society found a ſurpriſing coincidence, which made them more inclinable to a publication of them; and nothing more ſeemed to be wanting but M. *Huygen*'s conſent, without which, it was not thought proper to publiſh his diſcoveries, eſpecially as they were not then entire: In the mean time it was ordered, that they ſhould be laid up in the public archives of the Royal Society, and at the ſame time that thanks be returned to the author for his frankneſs in communicating them; and on the 4th of *Feb.* following he was earneſtly intreated to publiſh his theory, either at *Paris* in the journal *Des Sçavans*, or at *London* in the *Philoſophical Tranſactions*; and in a little time after this, Mr. *Oldenburg* had a ſecond letter from M. *Huygens* approving Sir *Chriſtopher Wren*'s theory, without making any mention of the publication of his own either at *Paris* or *London*: Whereby it appears, that M. *Huygens* was wanting to himſelf in diſpatching that publication, but he alſo by his putting it off, gave occaſion to Sir *Chriſtopher Wren*, who by the ſagacity of his own genius had made the very ſame diſcoveries, to claim a juſt title to ſome ſhare of glory therein; ſeeing it is plain, that neither of them had known any thing of each other's theories, before they were laid before the Society, but that both of them by the fecundity of their own genius gave birth to this beautiful offspring. It is true that M. *Huygens*, when he was at *London* ſome years ago, reſolved ſome of thoſe caſes about motion, that were propoſed to him; by which it plainly appears, that he was then maſter of thoſe rules, whereby he gave thoſe ſolutions; but he himſelf muſt own that he did not communicate the leaſt hint of his theory to any *Engliſhman*, tho' he was often ſolicited to it, till very lately. After having ſaid ſo much in favour of truth and juſtice, we ſhall now preſent the reader with M. *Huygens*'s rules.

Rules concerning the motion of bodies after mutual impulſe.

1. If a hard body ſhould ſtrike againſt another body equal hard at reſt, after contact the former will reſt, and the latter acquire a velocity equal to that of the moving body.

2. But if that other equal body be likewiſe in motion, and moving in the ſame direction, after contact, they will move with reciprocal velocities.

3. A body however great is moved by a body however ſmall, impelled with any velocity whatſoever.

4. A general rule for determining the motion of hard bodies ariſing from their direct impulſe.

Let A and B, fig. 2. Pl. VI. be two bodies, and let A be moved with the velocity A D, and B meet it, or move with the velocity B D towards the ſame part; or laſtly, let it be at reſt, that is, let, in this caſe, the point D coincide with B; dividing the line A B in C, the centre of gravity of the bodies A and B; let C E be taken equal to C D. I ſay E A will have the velocity of the body A after the ſtroke; and E B of the body B; and both will move towards that part, which the order of the points E A, E B do ſhow: But if E coincide either with A or B, the bodies A and B will remain at reſt.

5. The quantity of motion of two bodies may be either encreaſed or diminiſhed by their ſhock; but the ſame quantity, towards the ſame part, remains, after ſubſtracting the quantity of the contrary motion.

6. The ſum of the products ariſing from multiplying the maſs of any hard body into the ſquare of its velocity, is the ſame both before and after the ſtroke.

7. A hard body at reſt will receive a greater quantity of motion from another hard body, either greater or leſs than itſelf, by the interpoſition of any third body, of a mean quantity, than if it was immediately ſtruck by the body itſelf; and if the interpoſing body be a mean proportional between the other two, its action upon the quieſcent body will be the greateſt of all.

In all theſe caſes, the author, as he himſelf ſuggeſts, conſiders the bodies as homogeneous, or of the ſame matter; or poſſibly he means, that their maſs is to be eſtimated by their weight. He moreover ſubjoins that he has obſerved a ſurpriſing law of nature, which he can demonſtrate in ſpherical bodies, and which ſeems to hold univerſally in all others either hard or ſoft, either directly or obliquely impinging, *viz.* that the common centre of gravity of two, three or more bodies always moves equally towards the ſame part in a ſtraight line, both before and after the ſtroke.

Of the Reſolution of Equations *in Numbers*; *by Mr.* Collins. Phil. Tranſ. N° 46. p. 929.

THIS is part of a narrative formerly made by Mr. *Collins* on ſome late improvements of algebra in *England*; becauſe it was alledged that none were made ſince *Des Cartes*

Cartes time. And therefore he ſays, it was obſerved by many in *England*, that if, in any adfected equation, a ſeries or rank of roots be aſſumed in arithmetical progreſſion, the abſolute numbers or reſolvends, as to their firſt, ſecond or third differences, *&c.* proceed like the pure powers of an arithmetical progreſſion, of the ſame degree with the higheſt power, or firſt term of the equation, *e. gr.* in this equation $a^3 - 3a^2 + 4a = N$

If $a =$	then N, or the abſolute numbers or reſolvends, will be found to be	1. dif.	2. dif.	3. dif.
10	740	218	48	6
9	522	170	42	6
8	352	128	36	
7	224	92		
6	132			

The third differences of theſe reſolvends are equal as in the cubes of an arithmetical progreſſion.

In order to find the habitude or relation theſe differences have to the coefficient of the equation, it is beſt to begin with an unit.

If, in any arithmetical progreſſion, you multiply numbers by pairs, the reſult will be a rank of numbers, whoſe ſecond differences are equal; and if by ternaries, the third differences will be equal: And how to find the greateſt product, contained under any given numbers of any arithmetical progreſſion, is ſhown by M. *Paſcal* in his *Triangle Arithmetique*, where he applies it to the extraction of the roots of ſimple powers.

It is plain that this ſeries may be eaſily carried on by addition, till you have a reſolvend, either equal, greater, or leſs, than that propoſed.

When you have a *Majus* and *Minus*, you may interpolate as many more terms in the arithmetical progreſſion as you pleaſe, that is, ſubdivide the common difference, and render it leſs; and then find the reſolvends, which are eaſily had from the powers and their co-efficients, being ſuppoſed known; and they may be likewiſe readily obtained from a table of ſquares and cubes, *&c.* by this means you may have divers figures of the root; and then the general method of *Vieta* and *Harriot* becomes more eaſy, and after a figure is aſſumed for the root, by means of the ſubſequent dividend and diviſor, it may be certainly known, whether it was taken too great or too little.

After one root is obtained, the methods of *Huddenius* and others will depreſs the equations, till all of them are had.

 Mr.

Mr. *Collins* confidering that the conic fections may be projected from leffer circles of the fphere, and thereby eafily defcribed by points, and that by their interfections fome fpheric problem is determined; accordingly he found that this following problem, according to the various fituation of the eye, and of the projecting plane, would take in all cafes.

The diftances of an unknown ftar are given from two ftars of known declination and right afcenfion; the declination and right afcenfion of the unknown ftar is required.

And he obferves, that admitting the mechanical divifion of the circumference of a circle into any number of equal parts, or which is the fame, the ufe of a line of chords, that this problem, wherever the eye is placed, may be refolved by plain geometry, and yet the eye be fo fituated, as to determine it by the interfections of conic fections; confequently, thefe points of interfection, the fpecies and pofition of the figures being given, may be found without defcribing any more points than thofe fought; and the lengths of ordinates falling thence on the axes of either figure be calculated by mixt trigonometry; and hence likewife, the roots of all cubic and biquadratic equations be found by trigonometry: For having, from the mefolabe of *Slufius*, the fcheme that finds thefe roots, it will then be required to fit thofe fections into cones, which have their vertex either in the center or an affigned point of the furface of the fphere, and proceed to the folution of the problem; and how to fit in thofe fections, fee the 7 *Books* of *Apollonius Mydorgius*, the third volume of *Des Cartes*'s letters, *Leotandi geometria practica*, *Anderfonii exercitat. geometricæ*.

As to the problem itfelf, it is determined on the fphere by the interfections of the two leffer circles of diftance, whofe poles are the known ftars: And this problem is refolved geometrically feveral ways.

1. By plain geometry; fuppofing a plane to touch the fphere at the north pole; if the eye be in the fouth, projecting thofe circles on the faid plane, they are ftill circles, by reafon of the fub-contrary fections of the vifual cones, whofe centers fall in the fides of the right-lined angle, made by the projected meridians, that pafs thro' the known ftars; and thus the problem is eafily folved.

2. By conic geometry; in one cafe, it may be done, by placing the eye at the centre of the fphere, and projecting as above; *viz.* when the longer axes of the figures, being produced, meet above the vertex: Here the problem is determined

by

by the interſections of two conic ſections, of which, a circle cannot be one, unleſs its centre be in the axis of the other figure: And in this ſecond caſe, theſe points of interſections fall in the ſame right line, or projected meridian, they did before, but at a greater diſtance from the pole; for, in the former ſuppoſition, the polar diſtance was meaſured by a right line, that was the double tangent of half the arch; and here, it is the tangent of the whole arch: Hence, it is evident, how one projection may beget another, yea, infinite others, by altering the ſcale; and how the leſſer circles in the ſtereographic projection, help to deſcribe the conic ſections in the gnomonic one; but, to reduce the matter to one common radius, if we ſuppoſe two equal ſpheres, and ſo poſited about the ſame axis, that the pole of the one ſhall paſs thro' the centre of the other, together with the plane, and that a leſſer circle have the ſame poſition in both; then, if the eye be at the ſouth pole of the one, it is at the centre of the other; and any projected meridian drawn from the projected pole, paſs thro' the projections of theſe leſſer circles; the diſtances of the points of interſection, are the tangents of the half, and of the whole arch of the meridian ſo interſected: But as to the points of interſection, which determine the problem, they may be found by a gnomonic and ſtereographic method of meaſuring and ſetting off the ſides and angles of ſpherical triangles, and which is neceſſary in what follows.

3. If the problem is to be performed by mixt geometry, as by a circle, and either a parabola, hyperbola, or ellipſis, the circle may be conceived to be the ſub-contrary ſection of a cone, projected by the eye at the ſouth pole, and any of the other ſections by the eye at the centre of the ſphere.

4. If by any of the conic ſections, however poſited; the projecting plane may remain the ſame; but the eye muſt be in ſome other part of the ſurface of the ſphere, and not in the axis.

M. Huygen's *Inſtructions, for finding the* Longitude *with* Pendulum Watches. Phil. Tranſ. N° 47. p. 937.

THESE directions were firſt publiſhed by M. *Huygens*, and afterwards altered, or rather enlarged by two eminent members of the Royal Society.

1. Such as intend to uſe pendulum-watches at ſea, muſt be provided with two at leaſt, that if one of them ſhould fail, by chance, neglect, or ſhould by length of time become foul, the other may always remain in motion.

2. They

2. They muſt underſtand the internal parts of the watches, the manner of winding them up, and how to ſet the hands; the hours, minutes, and ſeconds being given.

3. The watches on ſhip-board are to be hung in a cloſe place, and where they may be freeſt from moiſture or duſt, and out of danger of being diſordered by knocking or touching.

4. Before the watches be brought on ſhip-board, it is convenient they be adjuſted to a mean day, their uſe being then moſt eaſy: Yet, notwithſtanding that, they may be uſed at ſea with equal certainty, provided you know, how much they go too faſt or too ſlow in 24 hours.

5. To adjuſt the watches, obſerve, that the ſun or the earth revolves in the ecliptic in about 365 days, 5 hours, 49 minutes; and that thoſe days, reckoning from noon to noon, are of different lengths: Now, between the longeſt and ſhorteſt of thoſe days, a day may be taken of ſuch a length, as that 365 days, 5 hours, 49 minutes, may be equal to that revolution; and this is called the equal or mean day, according to which the watches are to be adjuſted; and therefore, the hour and minute ſhewn by the watches, tho' they be perfectly juſt and equal, muſt needs differ almoſt continually, from thoſe ſhewn by the ſun, or ſuch as are reckoned by his motion: But this difference is regular, and is otherwiſe called the equation; and the following table is an eſtimation thereof.

Januar.

days	Jan.		Feb.		March		April		May		June	
	m.	fec.	m.	fec.	m.	fec.	m.	fec.	m.	fec.	m.	fec.
1	6	10	0	0	4	46	14	23	19	25	16	24
2	5	47	0	2	5	03	14	39	19	28	16	13
3	5	24	0	4	5	21	14	55	19	29	16	01
4	5	02	0	8	5	39	15	10	19	29	15	49
5	4	41	0	12	5	57	15	25	19	29	15	37
6	4	21	0	16	6	15	15	39	19	28	15	24
7	4	02	0	21	6	33	15	53	19	26	15	11
8	3	44	0	26	6	51	16	07	19	24	14	58
9	3	27	0	32	7	09	16	21	19	21	14	45
10	3	11	0	40	7	27	16	34	19	18	14	32
11	2	55	0	48	7	45	16	47	19	15	14	19
12	2	39	0	57	8	03	16	59	19	11	14	06
13	2	23	1	06	8	22	17	11	19	07	13	53
14	2	07	1	16	8	41	17	22	19	02	13	40
15	1	52	1	26	9	01	17	33	18	57	13	27
16	1	38	1	37	9	21	17	43	18	51	13	15
17	1	25	1	49	9	41	17	53	18	45	13	03
18	1	13	2	02	10	01	18	03	18	39	12	52
19	1	02	2	15	10	21	18	13	18	33	12	41
20	0	51	2	28	10	40	18	23	18	26	12	30
21	0	41	2	42	10	59	18	32	18	18	12	19
22	0	32	2	56	11	18	18	39	18	10	12	08
23	0	24	3	11	11	37	18	46	18	01	11	58
24	0	18	3	26	11	56	18	53	17	51	11	48
25	0	13	3	41	12	15	18	59	17	41	11	38
26	0	9	3	56	12	34	19	04	17	30	11	28
27	0	6	4	12	12	53	19	09	17	19	11	18
28	0	3	4	29	13	12	19	14	17	08	11	09
29	0	1			13	31	19	18	16	57	11	00
30	0	0			13	49	19	22	16	46	10	52
31	0	0			14	06			16	35		

days	*July*		*August*		*Sep.*		*October*		*Nov.*		*Dec.*	
	m.	sec.	m.	sec.	m.	sec.	m.	sec.	m.	sec.	m.	sec.
1	10	45	11	07	19	41	29	16	31	13	21	14
2	10	38	11	16	20	01	29	30	31	03	20	44
3	10	31	11	25	20	22	29	43	30	53	20	14
4	10	25	11	36	20	43	29	56	30	43	19	44
5	10	19	11	48	21	04	30	09	30	32	19	14
6	10	13	12	01	21	25	30	22	30	20	18	44
7	10	07	12	14	21	47	30	34	30	08	18	14
8	10	02	12	28	22	09	30	45	29	55	17	44
9	9	58	12	42	22	31	30	55	29	40	17	14
10	9	54	12	57	22	52	31	04	29	23	16	44
11	9	51	13	12	23	13	31	12	29	06	16	14
12	9	49	13	27	23	33	31	19	28	48	15	44
13	9	47	13	43	23	53	31	26	28	30	15	14
14	9	46	13	59	24	13	31	32	28	11	14	43
15	9	46	14	16	24	33	31	38	27	51	14	12
16	9	46	14	33	24	53	31	43	27	30	13	41
17	9	47	14	50	25	13	31	47	27	08	13	10
18	9	49	15	08	25	33	31	50	26	45	12	40
19	9	52	15	26	25	52	31	53	26	22	12	10
20	9	56	5	45	26	11	31	55	25	58	11	40
21	10	00	16	04	26	30	31	55	25	34	11	10
22	10	04	16	23	26	49	31	55	25	10	10	40
23	10	08	16	42	27	08	31	55	24	45	10	10
24	10	13	17	01	27	26	31	54	24	20	9	41
25	10	18	17	21	27	43	31	52	23	55	9	13
26	10	23	17	41	28	00	31	50	23	30	8	45
27	10	28	18	11	28	16	31	47	23	04	8	17
28	10	34	18	21	28	32	31	43	22	38	7	50
29	10	41	18	41	28	47	31	37	22	11	7	23
30	10	49	19	01	29	02	31	30	21	43	6	58
31	10	58	19	21			31	22			6	34

By

By this table, you may always know what o'Clock it is by the ſun preciſely, and conſequently whether the watches have been ſet to the juſt meaſure of the mean day, or not; and it is to be uſed thus: When you firſt ſet your watch by the ſun, ſubſtract from the time obſerved by the ſun, the equation anſwering to that day of the month in the table, and ſet the watches to the remaining hours, minutes and ſeconds; that is, the watches are to be ſet ſo much ſlower, than the time of the ſun, as is the equation of that day; ſo that the equation of the day, added to the time by the watch, is the true time by the ſun: And if you would know by the watch the time by the ſun, add to the time of the watch the equation of that day, and the ſum is the time by the ſun, if the watch has been well adjuſted; for doing of which, take the following method; draw a meridian line on a floor, then hang two plummets by two ſmall threads or wires, directly over that meridian, at about two foot from each other; when the middle of the ſun, the eye being ſo placed as to bring the two threads into one line, appears to be exactly in the meridian, for the better and more ſecure viewing of which, you muſt be provided with a glaſs of a dark colour, or a little blacked with the ſmoak of a candle, then ſet the watch immediately, not preciſely to the hour of 12, but by ſo much leſs, as is the equation of that day by the table; *e. gr.* if it were the 12th of *March*, the equation of that day being by the table, 8 min. 3 ſec. ſubſtract theſe from 12, and the remainder will be 11 hours 51′ 57″, to which you are to adjuſt the index of your watch: Then after ſome days obſerve again in the ſame manner, and likewiſe note the hour, min. and ſec. of the watch, to which you are to add the equations of theſe days; and if the ſum be juſt 12 hours, the watch is truly adjuſted; but if it differs, divide the min. and ſec. of that difference by the number of the days between the two obſervations, that you may have the daily difference: Suppoſe this ſecond obſervation were made the 20th of *March*, *viz.* 8 days after the firſt, and obſerving the middle of the ſun in the meridian in the ſame line with the two threads, the watch points 11 h. 51′ 7″ the equation of the 20th of *March* by the table is 10′ 40″, which added to the time of the watch, gives 12 h. 1′ 47″. If it had been juſt 12 hours, the watch had been well adjuſted, but being 1′ 47″ over 12, it has gone ſo much too faſt in 8 days: And theſe 1′ 47″ or 107″ being divided by 8, there comes 13″ $\frac{3}{8}$ for the difference of every 24 hours; which difference being known, if you want opportunity, or have no mind to take the trouble of adjuſting the watch, obſerve only the daily difference,

and regulate yourſelf accordingly; but if you would adjuſt it better, remove the leſs weight of the pendulum a little downwards, which will make it go ſlower, and then obſerve a-new by the ſun, as before: If it had gone too ſlow, remove the ſame weight ſomewhat upwards. And this is of ſuch importance in finding longitude, that if not regarded, you may in the ſpace of three months miſreckon upwards of ſeven deg. and yet without any fault in the watches, which under the *Tropics* will amount to upwards of 400 *Engliſh* miles. Having ſhewn how watches may be adjuſted on land, or how their daily difference may be known; next follows, how the ſame may be done, when a veſſel rides at anchor, it being hardly practicable, when under ſail: In the morning, when the ſun is half above the horizon, obſerve the time by the watch, if it be going, if not, ſet it a going, and put the indexes at what hour, minute and ſecond you pleaſe: And let them go till ſun-ſet, and when the body of the ſun is juſt half below the horizon, obſerve the time by the watch; and reckon how many hours, &c. are paſſed by the watch between the two obſervations; which is done by adding to the evening obſervation the hours, &c. that the morning obſervation wanted of 12, or 24, providing the hour hand has in the mean time paſſed that hour once or twice; otherwiſe, the difference only gives the time; then take the half of that number, and add it to the hours, &c. of the morning obſervation, and you will have the hours, &c. which the watch did ſhew, when the ſun was in the ſouth, to which add the equation of that day in the table, and obſerve the ſum: Again, ſome days after this, the more days the better, make the very ſame obſervations, and if the hour of this laſt day be the ſame with that of the former obſervation, the watch is well adjuſted, but if more or fewer, the difference divided by the time elapſed between the two obſervations, will give the daily difference: Inſtead of the ſun's riſing and ſetting you may take two altitudes, before and after noon, and noting the time by the watches at both obſervations, proceed as above; in either of theſe methods there may be ſome error ariſing from the ſun's refraction, which is inconſiderable, and therefore may be neglected.

6. By theſe watches to find the longitude of any place at ſea, give each of them a name or mark, as A, B, C; and before you ſail, adjuſt them to the time obſerved by the ſun in the place, where you are, and whence you are ſailing, allowing for the equation of the day, you make your obſervations on; which day you are to note, if the watches be not well adjuſted, otherwiſe it

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is not neceſſary: Then, after you are at ſea, if you want the longitude of the place, where you are, that is, how many degrees the meridian of that place is more eaſterly or weſterly, than that of the place where you ſet the watches; obſerve by the ſun or ſtars as preciſely as poſſible, the time of the day, and note at the ſame time, the hour, *&c.* by the watches, which time, if the watches be not ſet to the right meaſure, is to be adjuſted by the daily known difference, and to the time by the watch add the equation of that day, which gives the hour of the day by the ſun, at the place where the watches were ſet; and if it be the ſame with that obſerved where you are, then the two places are under the ſame meridian, but if either greater or leſs, you are more eaſterly or weſterly; and reckoning for every hour, 15° of longitude, and for every minute, 15′ or ¼ of a degree, you will then know how many degrees, minutes, *&c.* the meridians differ from each other; *e. gr.* ſuppoſe the watches A, B, C, were ſet at the place, whence you failed, on the 20th of *Feb.* from the time by the ſun, deducting the equation of that day, *viz.* 2′. 28″. and ſuppoſing watch A be rightly adjuſted, but that B goes every day 7″ too ſlow, and C 12″ too faſt: Some days after, ſuppoſe the 5th of *May*, if you would know the longitude of the place where you are at ſea, and you obſerve the

	h.	m.	ſec.
time of the day there, to be — — — —	5,	18,	10
And you find the watch A point at — —	2,	6,	0
But the watch B, at — — — — —	1,	57,	22
Going too ſlow by 7″ every day, which in 74 days, *viz.* from *Feb.* 20th to *May* 5th, is —	0,	8,	38
Which being added to its own time, gives the ſame, with that of the watch A, *viz.* — —	2,	6,	0
And you find the watch C point at — —	2,	20,	48
Going 12″ too faſt every day, which makes in 74 days, — — — — — — —	0,	14,	48
Which ſubducted from its own time, gives	2,	6,	0
The time of the day by the watches, being	2,	6,	0
Add to it the equation of *May* the 5th. —	0,	19,	29
And ſo you have for the time of the day at the place where the watches were ſet. — — —	2,	25,	29
But the time obſerved being — — —	5,	18,	10
Exceeds this by — — — — — —	2,	52,	41
Wherefore the meridian of the place, where you are *May* the 5th, is more eaſterly than the place where the watches were ſet. — — — —	2,	52,	41

Which being reduced to degrees, reckoning 15° for an hour, comes to — — — — } 43, 10, 15

It is true, that from the ſame reckoning it may be concluded, that you are 180 deg. more eaſterly; which happens, becauſe the hour index goes round in 12 hours; but the difference is ſo great, that one cannot be deceived in it; elſe the watch might be ſo made, that the index ſhall go round once in 24 hours.

7. To find the time of the day at ſea; this has been ſhown above to be neceſſary in finding the longitude, and that time is to be obſerved as preciſely as poſſible; for every minute of time you miſreckon, cauſes an error of $\frac{1}{4}$ of a degree in longitude, which, near the equator, amounts to above 15 *Engliſh* miles, but leſs elſewhere: Wherefore to find the time of the day with certainty, you muſt not truſt to the obſervation of the ſuns greateſt altitude; thence to conclude that it is juſt noon, or that the ſun is in the ſouth, unleſs between the *Tropics* you have him juſt in the zenith; for the ſun being near the meridian, continues for ſome time, without any ſenſible alteration of his altitude; much leſs are you to rely on ſea compaſſes, for finding the preciſe time of noon; nor are aſtronomical rings or other ſorts of ſun-dials exact enough for ſhowing the time to minutes and ſeconds; but the beſt way, is to obſerve the ſun's altitude, when he is in the eaſt or weſt, for there, his altitude changes in a little time more ſenſibly; and thus from the height of the pole and ſun's declination, the hour may be calculated; but becauſe this calculation is ſomewhat troubleſome, and there may be errors in taking the ſuns altitude, here follows an eaſier method, without knowing the height of the pole, or the ſun's declination, or the uſe of any aſtronomical inſtruments: Nor can the refractions of the ſun or ſtars cauſe any conſiderable error; the morning refraction differing little or nothing from the evening of one and the ſame day, and eſpecially at ſea.

8. To find the longitude at ſea by obſerving the ſun's riſing and ſetting, and the time by the watches; at the riſing and ſetting of the ſun, when half above the horizon, obſerve the time of the day by the watches; and tho' you have in the mean time ſailed on, it is not conſiderable; then reckon by the watches the time elapſed between the obſervations, and add the half thereof, to the time of the riſing, and you will have the time by the watches, when the ſun was at ſouth; to which add the equation of the day by the table; and if the ſun be 12 hours, then was the ſhip at noon under the ſame meridian with the place where the watches were ſet by the ſun; but if the ſum exceed 12, then

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ſhe was at noon under a more weſterly meridian, and if leſs, than under a more eaſterly meridian; and that, by as many 15 degrees as that ſum exceeds or falls ſhort of 12: Suppoſe *e. gr.* that the watches A and B, as before, were ſet with the ſun, at the place, whence you ſailed, *Feb.* 20th, deducting the equation of that day, *viz.* 2′ 20″, the watch A being adjuſted, and B going too ſlow by 7″ a day; and deſiring to know the longitude of the place, where you are *May* 22d, you obſerve in the

	h.	m.	ſec.
morning the ſun half above the horizon, when the watch points at — — — — —	2,	30,	10.
And in the evening, the ſun being half below the horizon, when the watch points at — —	3,	8,	40,
To find the time elapſed between them, ſubſtracting the time of the riſing — — — —	2,	30,	10.
From — — — — — — — —	12,	00,	00.
There remains — — — — — —	9,	29,	50.
Adding thereto the time of the ſetting — —	3,	8,	40.
You have for the time elapſed between the obſervations — — — — — —	12,	38,	30.
Whereof the half — — — — — —	6,	19,	15,
Being added to the time of riſing — — —	2,	30,	10.
You have the time by the watch A, when the ſun was in the ſouth — — — — —	8,	49,	25.
And after the ſame manner you are to ſeek the time by the watch B, when the ſun was in the ſouth, which ſuppoſe — — — —	8,	38,	48.
But this watch going 7″ a day too ſlow, it falls ſhort in 91 days, *viz.* from *Feb.* 20th to *May* 22d — — — — — — —	0,	10,	37.
Which therefore added to the ſaid time gives	8,	49,	25.
That is, the ſame time given by the watch A; now adding to this time of the watches, the equation of *May* 22d, you have — —	9,	7,	35.

Which is the ſame time of the day, with that of the place where the watches were adjuſted, and whence the ſhip ſailed.

	h.	m.	ſec.
The difference is — — — — — —	2,	52,	25.
Wherefore this laſt meridian is by ſo much more eaſterly than the firſt; which being reduced to degrees, make — — — —	43,	6,	15.

It is manifeſt, that by this method, you find exactly enough, the longitude of the place, where you were at noon, or the time of the ſun's being in the ſouth: Which, tho' it differ from the longi-

longitude of the place, where you are at obſerving the ſun's ſetting, yet you may eſtimate near enough, how much you have advanced, or changed the longitude in thoſe few hours, by the log-line, or other ordinary methods of reckoning the ſhip's way, or which is ſureſt, by the degrees paſſed in 24 hours, by a former day's obſervation.

You may likewiſe, inſtead of obſerving the ſun's riſing and ſetting, obſerve the ſetting firſt, and then next morning, the riſing; at both times marking the time by the watches, and thence find, as above, the longitude of the ſhip's place at midnight.

In fine, you may alſo, inſtead of the riſing and ſetting ſun, obſerve before and after noon two equal altitudes of the ſun, noting the time by the watches, and reckoning, as above; yet it is to be obſerved, that the ſun's altitudes are beſt taken, when he is about eaſt or weſt: But note, that in ſailing north or ſouth, you take not the obſervations at the ſun's riſing and ſetting, but when he is due eaſt and weſt.

9. But you may put the rule here preſcribed in practice, by taking two equal altitudes of ſome known ſtar, that riſes high above the horizon; for you will thence, according to the rule, know, by the watches, at what time the ſtar has been in the ſouth; and ſo knowing the right aſcenſion of that ſtar, as alſo that of the ſun, you may thence eaſily calculate, what time it then was; which compared with the time by the watches, will give the longitude of the place, where you were, when you had the ſtar in the meridian.

10. If the watches, that have gone exactly for a while, ſhould happen to differ; in that caſe, it will be beſt to reckon by that, which goes faſteſt; unleſs you perceive any apparent cauſe, why it goes too faſt; ſeeing it is not ſo eaſy for theſe pendulum watches to move faſter than at firſt, as it is to go ſlower; for the wire, on which the pendulum hangs, may perhaps, by the violent agitation of the ſhip, come to ſtretch a little, but it cannot grow ſhorter; and the bob of the pendulum may perhaps ſlip downwards, but cannot get up higher.

11. When you get ſight of any known country, iſland, or coaſt, take the longitude thereof as exactly as poſſible, by the rules here preſcribed: That, thereby, you may correct the ſea-maps; and that you may know how far you have ſailed from any place, either eaſt or weſt: And if by any accident, the watches ſhould ſtop, you may at any place, whoſe longitude is exactly known, ſet them a going again, and adjuſt them there by the ſun, and ſo reckon the longitudes from that meridian.

12. If

12. If all the watches ſhould happen to ſtop at ſea, you muſt, as ſoon as poſſible, ſet them a-going again, that you may know, how much you advance from that place, either eaſtward or weſtward, which is of no ſmall importance; ſince, for want of this knowledge, you are ſometimes, by the force of currents, carried away, that tho' you ſail before the wind, yet you are driven a-ſtern, of which there are many inſtances.

An Account of two Parhelia's *in* Hungary; *by Dr.* Edw. Brown. Phil. Tranſ. N° 47. p. 953.

THIS account was communicated to Dr. *Brown*, by one father *Michael*, a learned jeſuit, at *Presburg*. *Jan.* 30, 1669, N. S. About one o'clock in the afternoon, two parhelia's, or mock-ſuns, were ſeen over the city of *Caſſovia* in *Hungary*; there was one on each ſide of the ſun, and ſo reſplendent, that the naked eye could not bear their brightneſs; the leſſer began to decay before the other, and then that other grew bigger, and laſted near two hours, projecting very long rays: On that ſide, next the ſun, they were tinged with a pale yellow, the other parts being ſomewhat obſcure. At the ſame time, ſeveral rainbows were ſeen, together with the ſegment of a great white circle, that laſted very long, paſſing thro' the two parhelia's and the ſun; and all this at a time, when the air was almoſt free from clouds, tho' here and there ſome thin ones were ſcattered.

Conferences held at Paris *in the* Royal Academy, *for the Improvement of the Arts of* Painting *and* Sculpture. Phil. Tranſ. *ibid.*

THESE conferences are held once a month by ſeveral able maſters, who make reflections and obſervations upon the moſt curious pieces in his moſt chriſtian majeſty's cabinet, the founder of that academy. M. *Colbert*, whoſe peculiar care it was, to make arts flouriſh in *France*, making a viſit to them, and having received an account of what was done at their meetings, expreſſed himſelf thus, that as it was neceſſary for the teaching of arts, to join examples with precepts; ſo he thought it proper, that from time to time, the works of the moſt excellent painters ſhould be examined, and ſuch obſervations made on them, as would inform others, wherein the perfections of a picture conſiſted: Which ever ſince they have done, as the beſt means of carrying that art to its higheſt pitch; for ſuch an examen of the beſt pieces diſcloſes many beauties, for which there are no rules,

and

and affords an opportunity of discussing several questions, hitherto untouched.

The particulars, which have been made public, of these conferences, are,

First, a general idea of the art of painting, consisting of two principal parts, the theory, and the practice; and it is observed, that the authors on painting, have very much neglected the former, tho' so very important, both as to the design and disposition of the pieces.

Secondly, an account of seven conferences, six of which were made on as many pieces of *Raphael*, *Titian*, *Paul Veronese*, and the seventh, on that of *Laocoon*.

M. *le Brun*, considering a piece of *Raphael*, representing the combat of St. *Michael* with the devil, observes, that the expression depends in a particular manner on the bodies that surround the figures, and that the motion and action in the figure of St. *Michael* is owing thereto, who seems to be animated in this piece; for his body, incumbent on the air, seems to drive it on high with violence, to make way for his descent.

In another piece, where *Titian* represents the body of Christ carried to the grave, M. *de Champagne* the elder, observes the dexterity of the master in ordering the colours and light; that the legs of the picture, which first present themselves, may stand out, he has wrapped them about with a very white linnen sheet; and cloathed *Nicodemus*, who holds them, with a very vivid and clear lacca; on the contrary, in order to sink the rest of the body, he has so disposed the light of the picture, that the shadow of *Joseph* of *Arimathea*, who helps to support the legs, falls on its head and shoulders, which heightens the image of death on the body; the arrangement of the colours, is likewise very remarkable in the draperies; for, between the green of *Joseph* of *Arimathea*, and the blue mantle of the blessed virgin, is the yellow cloathing of *Mary Magdalen*, wherein, what is brown and dusky is tempered by the different surrounding colours, that the eye may pass gradually from one colour to another: And because the sleeve of *Mary Magdalen*, which is of a bright yellow, is close to the lively drapery of *Nicodemus*; the artist, to prevent the entrenching of these two colours on each other, has turned up *Nicodemus*'s sleeve against the yellow, so that we pass from the shadow of one colour to that of the other.

The art of the picture, treated of in the fifth conference, is no less remarkable; in this, which is a piece of *Paul Veronese*, is a woman,

woman, whoſe carnation colour is ſo freſh and ſo bright, that it dazles the eyes: M. *Nocret*, examining the cauſe of this beauty, obſerves, that it proceeds in part, from the artiſt's having ingeniouſly drawn, before her, a child in brown drapery; behind her a man in black; and on her ſide, a *Negro*, who make an admirable contraſt to the great luſtre and ſplendor of the carnation.

The two laſt conferences, on two pieces of M. *Pouſſin*, furniſh among other things, very elegant examples of different characters, ſuitable to different perſons: This maſter being to repreſent ſeveral perſons gathering manna, gives them different attitudes and poſtures, anſwerable to their characters; on the forepart of the picture are two youths, who according to the genius of that age, fight about the manna; near to them are men gathering it in the mean time, and eating thereof; at a little diſtance appears a girl, who loth to take the pains of ſtooping, holds out her coat to receive it as it falls, and fancies heaven pours it down for none but herſelf; which, according to the obſerver, well expreſſes the ſoft temper of that ſex, averſe to labour, and imagining every thing muſt happen, as they would wiſh; in the other piece, repreſenting the two blind men, to whom our ſaviour reſtored ſight; there is an old man, very inquiſitive and prying, ſeeming as if he doubted of the truth of the miracle, the artiſt well expreſſing the character of that age, which is to be incredulous and diffident.

The Generation of an Hyperbolical Cylindroid, *and a Hint of its Application for grinding* Hyperbolical Glaſſes; *by Sir* Chriſt. Wren. Phil. Tranſ. N° 48. p. *961*. Tranſlated from the *Latin*.

LET (Fig. 3. Plate VI.) D B E C, be two oppoſite hyperbola's, whoſe tranſverſe axis is B C, their centre A, and one of the aſſymptotes G P; and thro' the centre draw O M perpendicular to B C; wherefore, if the two hyperbola's do revolve round their axis O M, it is plain, a body called an hyperbolic cylindroid will be generated by that rotation, whoſe baſes, and all the ſections parallel to them, are circles: I ſay likewiſe, that if the body be cut by the aſſymptote G P, the ſection will be a parallelogram: Let it be cut thro' the tranſverſe axis into a circular ſection B N C, and alſo, thro' O and M into equal circles, and at equal diſtances from the centre; and likewiſe thro' the axis, into the generating figure, whoſe half, is B D E C, and in whoſe plane will be the aſſymptote G P, thro' which, let the plane B D E be cut at right angles in the plane F H P, and join O H.

Becauſe the triangle OGH is rectangular, therefore the ſquare of OH, or OD, *minus* the ſquare of OG is equal to the ſquare of GH; and becauſe DO is parallel to BA, and cuts the aſſymptote in G, it will be from the properties of the hyperbola, which are demonſtrated in conic ſections, the ſquare of OG, together with the ſquare of AB, equal to the ſquare of OD; that is, the ſquare of OD *minus* the ſquare of OG, equal the ſquare of AB, or of AN; therefore the ſquare of GH, is equal to the ſquare of AN; wherefore GH and AN are equal, and at right angles to GA; and the ſame alſo is demonſtrated of all other ſections parallel to the baſe; conſequently an hyperbolical cylindroid being cut by an aſſymptote, the ſection is a parallelogram Q. E. D.

Cor. Hence it appears, that on the ſurface of a cylindroid, tho' conſiſting of a double flexure, innumerable right lines may be drawn, as alſo, that this body, may be otherwiſe generated, *viz*. by the revolution of a parallelogram about the axis, the angle at the axis GAO remaining equal, or the generating line HR continuing immoveable, and either generating, or cutting the body; and if a ſharp and ſtraight edge-tool have the ſame ſituation to the axis with the generating line, while the chuck turns round, it is plain, that hyperbola's may be as accurately wrought by the lathe, as circles; ſince nothing more is required for the formation of a cylindroid, than for that of a cylinder, except that in cylinders, the edge of the tool is parallel to the axis, but here inclined; therefore it is to be obſerved, that the ſpecies of the hyperbola is varied, according to the inclination of the angle GAO; conſequently, it may be ſo eaſily fitted to a given hyperbola, that there is no need of demonſtrating the thing farther; but if the angle continuing the ſame, the generating line approach nearer the centre, a leſs hyperbola thence ariſes, but entirely ſimilar to the former.

Of the Motion of the Sap *in* Trees; *by* Mr. Willoughby *and* Mr. Wray. Phil. Tranſ. N° 48. p. 963.

IN birch trees, the ſap iſſues out of the leaſt twigs of branches and fibres of roots, in proportion to their bigneſs.

From branches that bend downwards more ſap iſſues than from others of the ſame bigneſs in a more erect poſition.

Branches and young trees cut quite off when full of ſap, and held perpendicularly, will bleed; and if you cut off their tops, and invert them, they will bleed likewiſe at the ſmall ends.

Roots

Roots of birch and ſycamore cut aſunder will bleed both ways, that is, from the part, remaining to the tree, and the part divided from it; but a great deal faſter from the former; and in a cold ſnowy day, the root of a ſycamore bled ten times faſter than it did before in warm weather.

In birches, the ſap does not iſſue out of the bark, tho' never ſo thick; but as ſoon as you have cut the bark quite thro', it then firſt begins to bleed.

The paring off the bark of ſeveral birches above an hand's breadth round, abated their bleeding above the bared places, but did not quite ſtop it.

The ſap aſcends not only between the bark and tree, and in the prick'd circles, between the ſeveral coats of wood, but alſo thro' the very body of the wood; for, ſeveral young birches being nimbly cut off at one blow with a ſharp ax, and a piece of white paper immediately held hard on the top of the remaining trunk, pins were ſtuck in all the parts of the paper that appeared wet; and at laſt, moſt of the paper becoming wet, upon removing it, but leaving the pins ſticking, they were found without any order, ſome in the circles and ſome in the wood between: And to confirm this, the body of the tree was cut a-ſlope, and likewiſe the oppoſite ſide, till the top was brought to a narrow edge, and ſo ordered, that the whole edge conſiſted of part of a coat of wood, and had nothing of a pricked circle in it, notwithſtanding which, the ſap aſcended to the very top of this edge and wetted a paper laid upon it.

In order to find out the motion of the ſap, and to know whether it not only aſcends, but likewiſe deſcends, there was a hole bored in a large birch, out of which a drop fell every fourth or fifth pulſe; then about a hand's breadth below the hole, the body of the tree was ſawed deeper than the hole: Whereupon the bleeding diminiſhed about one half; and ſawing above the hole to the ſame depth, its bleeding ceaſed quite; and from the ſawed furrow below it, decreaſed about half; but it continued bleeding a great while after, at both the ſawed furrows, the hole in the middle remaining dry. This experiment was repeated with much the ſame ſucceſs on a ſycamore.

Some trees of the ſame kind and age bleed a great deal faſter and ſooner than others; but always old trees ſooner and faſter than young.

A wound made before the ſap riſes, will bleed when it does riſe.

Upon making theſe experiments, the weather changed from warm to very cold; whereupon, the bleeding of the birches, which began to abate before, quite ceaſed; but all the ſycamore and walnut-trees, that were wounded, bled plentifully; ſome of which did not bleed at all before, and ſuch as did, but ſlowly; and ſo continued night and day, when it freezed ſo hard, that the ſap as it dropped congealed: The cold remitting, the birches bled a-freſh, the ſycamores abated very much and the walnut-trees quite ceaſed.

Upon piercing two ſycamores on the north and ſouth ſides, with equal inciſions, they bled a great deal faſter on the north than ſouth ſides, which agrees with the preceeding experiment.

Several willows were ſet with the wrong ends downwards, and ſeveral briars cut off, that had taken root at the ſame extremity; the former ſhot out branches near two foot long; and from the top of the ſets, which were a yard high, the briars alſo grew backward from that part, which was left remaining to the roots at the ſmaller ends, and they had great leaves and were ready to flower.

Damps in Mines; *by* Dr. Edw. Brown. Phil. Tranſ. N° 48. p. 965.

DAMPS are obſerved in moſt of the *Hungarian* mines, that are deep, and that not only in the *Cuniculi*, or direct paſſages, by theſe miners called *Stollen*, but likewiſe in the *Putei*, or perpendicular cuts and deſcents, termed *Schachts:* They are met with not only in places, where the earth is full of clay, or the like ſubſtances, but alſo, where it is rocky: And the Dr. was ſhown one place in the copper mine at *Herrn-groundt*, where there had been a very pernicious damp, and yet the rock ſo hard, that it could not be broken by their inſtruments; and the deſcent was made with gun-powder, rammed into long round holes in the rock, and thus blown up: And he was ſhown another place, where there is ſometimes a damp, and ſometimes clear weather: When there is much water in the mine, ſo as to ſtop up the lower part of this paſſage, then the damp becomes diſcoverable, and commonly ſtrong: He procured one to enter it, till his lamp went out four or five times, in the ſame manner as in *Grotto del Cane* in *Italy*.

Damps are not all of the ſame force, but ſome are weaker, and ſome ſtronger; ſome ſuffocate in a little time, others again only make the workmen faint, without any further harm, unleſs they continue long in the place. The miners cure the damp, or bad weather as they term it, by perflation, by letting the air in and out, and ſo promoting its circulation: In the mine at *Herrn-groundt*, they cured a damp by a great pair of bellows, blown continually for many days. The ordinary remedy is by long tubes, thro' which the air continually paſſing, they can dig ſtraight on for a long way, without any impediment in breathing: Some *Cunicula* are 500 fathoms long: In the ſilver trinity-mine by *Schemnitz*, he paſſed quite under a great hill, and came out on the other ſide: At wind-*Schach* mine near *Schemnitz*, he was ſhown a place, where five men and a gentleman of quality were loſt, for which reaſon they have now placed a tube there; the like they do over all *Doors*, and all *Ways*, where they dig ſtraight on, for a great ſpace, and have no paſſage thro': At *Chremnitz* 28 men had been killed at one time in 4 *Cuniculi*; and in the ſinking of *Leopold*'s pit, which is 150 fathoms deep, they were much troubled with damps, which they cured in this manner: They fixed a tube to the ſide of the *Schacht* or pit, from top to bottom; and that not proving ſufficient, they forced down a broad flat board, which covered or ſtopped the pit on all ſides, but where the tube was; and ſo forced out all the air in the pit thro' the tube; which they were forced often to repeat; and now having divers other paſſages into it, the air is good and ſufficient; and he himſelf was drawn up thro' it without the leaſt trouble in breathing.

But beſides the miſchief from poiſonous exhalations, ſtagnations of the air, or water impregnated with mineral ſpirits, the miners ſometimes periſh by other means; for there being in theſe mines incredible maſſes of wood for ſupporting the pits and horizontal paſſages, men are ſometimes deſtroyed by this wood being ſet on fire: And in the gold mine at *Chremnitz*, the timber was once ſet on fire, and 50 miners periſhed; who were all taken out to one, who was afterwards found to be diſſolved by the vitriol water, nothing being left entire, except ſome of his cloaths.

A Chro-

A Chronological Account of the ſeveral Eruptions of Mount Ætna. Phil. Tranſ. N° 48. p. 967.

TO omit what is related by *Beroſus*, *Orpheus* and other leſs credible authors about the eruptions of this mountain, both at the time of the expedition of the *Ionian* colonies, and that of the *Argonautæ* into the iſland of *Sicily*, which latter happened in the 12th century before *Chriſt*; the firſt, we ſhall take notice of, is that, which happened at the time of the expedition of *Æneas*, who, being affrighted at the burning of this mountain, left that iſland; of which *Virgil Æneid.* III. gives this deſcription.

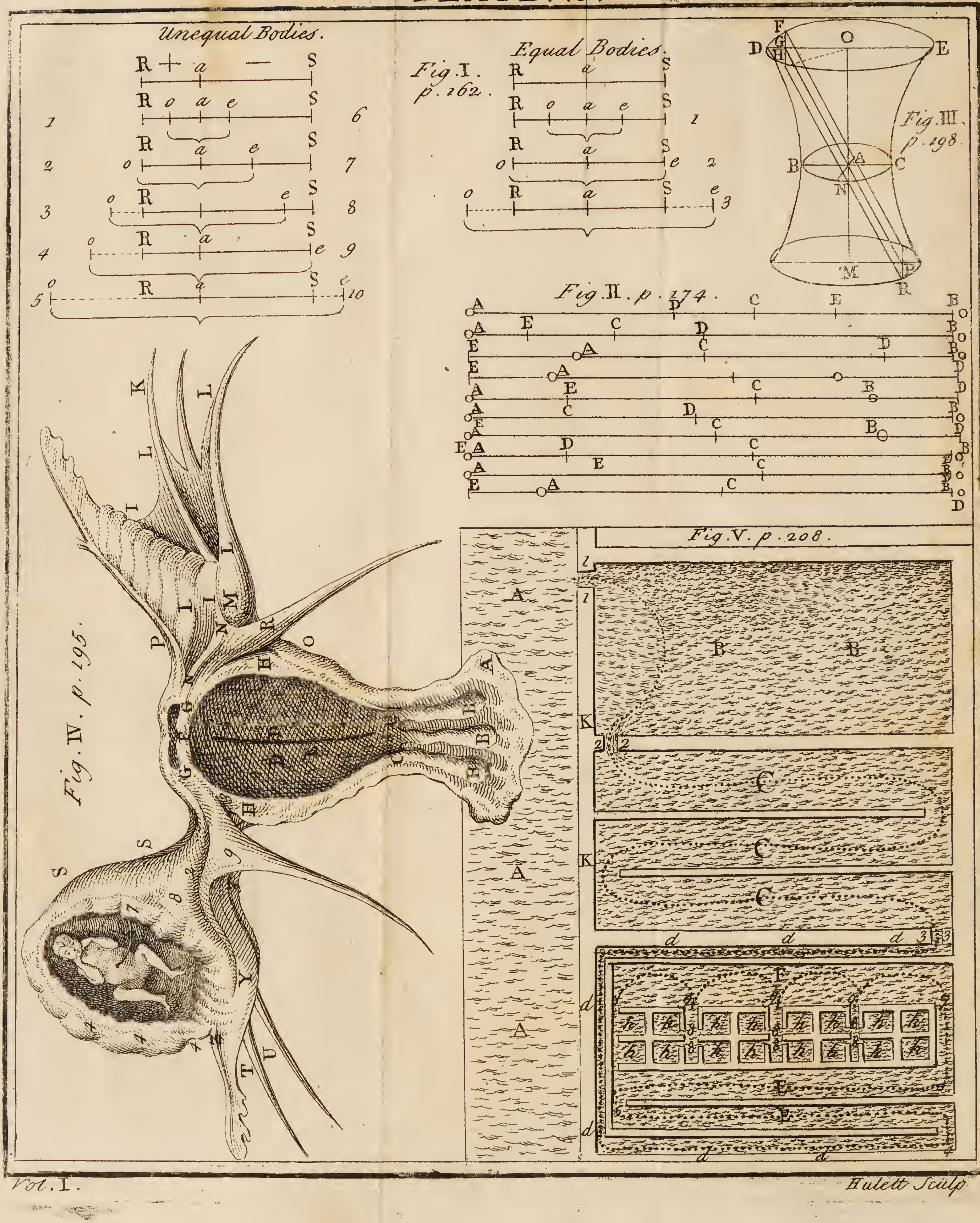
Ignarique viæ, Cyclopum allabimur oris.
Portus ab acceſſu ventorum immotus & ingens
Ipſe; ſed horrificis juxta tonat Ætna ruinis;
Interdumque etiam prorumpit ad æthera nubem,
Turbine fumantem piceo, & candente favillâ;
Attolitque globos flammarum, & ſidera lambit;
Interdum ſcopulos, avulſaque viſcera montis
Erigit eructans, liquefactaque ſaxa ſub auras
Cum gemitu glomerat, fundoque exæſtuat imo.

——— And unknowing of our Courſe
We drive upon the *Cyclop*'s Coaſts: The Port
Fenc'd by its Situation from the Winds,
And large itſelf: But *Ætna* thunders nigh
In dreadful Ruins. With a Whirl-winds Force
Sometimes it throws to Heav'n a pitchy Cloud,
Redden'd with Cinders, and involv'd in Smoke;
And toſſes Balls of Flame, and licks the Stars:
Sometimes with loud Exploſion high it hurls
Vaſt Rocks, and Entrails from the Mountains torn;
With roaring Noiſe flings molten Stones in Air,
And boils, and bellows, from its loweſt Caves.

TRAPP.

After this, in the 76 olympiad, about 476 years before Chriſt, we find in *Thucydides* another burning, and about 50 years after that a third. And in the time of the *Roman* conſuls, according to *Diodorus Siculus* and *Polybius*, there happened four eruptions of mount *Ætna*: The next was in the time of *Julius Cæſar*, and ſaid by *Diodorus* to have been ſo fierce, that the ſea about *Lipara*, an iſland near *Sicily*, by its fervent heat burnt the ſhips, and kill'd all the fiſhes therein. There was another

PLATE. VI.



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another under *Caligula*, about 40 years after Chriſt, which was ſo dreadful, that it made that emperor, who was then in *Sicily*, fly for it. It burnt again A. C. 812 under *Charlemagne*: And from the year 1160 to 1669, all *Sicily* was ſhaken with many terrible earthquakes; the eruptions of *Ætna* deſtroyed a vaſt tract of inhabited Land round about it, and reached as far as *Catania*, whoſe cathedral, and the Religious in it, were deſtroyed: In 1284 about the time of the death of *Charles* king of *Sicily* and of *Arragon*, there was another dreadful burning. *An.* 1329 to 1333 another. *An.* 1408 another, and *An.* 1444 another, which laſted to 1447: *An.* 1536, there was an eruption which continued for a whole year, and 1633 another, that laſted ſeveral years; An. 1650 it burned on the eaſt ſide, and vomited ſuch quantities of fire, as, according to *Kircher* in his *Mundus Subterraneus*, made great devaſtations: And the ſame author, being in *Sicily*, obſerves that the people of *Catania*, digging for pumice-ſtones, found at the depth of 68 foot, ſtreets paved with marble, and many footſteps of antiquity; an argument, that towns formerly ſtood there, tho' ſince buried in the eruptions of that mountain; they alſo found ſeveral bridges of pumice-ſtones, probably made by the flux of theſe fiery torrents.

A Woman with a double Matrix; *by* M. Benoit Vaſſal. Phil. Tranſ. N° 48. p. 969.

FIG. 4. Plate VI. repreſents a double matrix obſerved by Mr. *Vaſſal* ſurgeon at *Paris*, upon opening the body of a woman of 32 years of age, of a ſanguine conſtitution, and maſculine air: Theſe two matrixes were ſo well diſpoſed by an extraordinary contrivance of nature, that the true one had conceived ſeveral times, *viz.* 7 males and 4 females, all born at the full time, and all perfectly well formed; but they were at laſt followed by a brother, yet a fœtus, conceived in an adjoining *Uterus*, in a place ſo little capable of diſtenſion, that ſeeking enlargement, after it had cauſed grievous ſymptoms to the mother for two months and a half, it at laſt, being about 3 or 4 months old, break out, and found its grave in that of its mother, by a very great effuſion of blood in the whole capacity of her abdomen, which threw the mother into ſuch violent convulſions for three days together, that ſhe died of them.

The explication of the figure; A, a portion of the *Vagina*; B, the internal orifice of the *Uterus* laid bare; C, the neck of the *Uterus*; D, the cavity of the *Uterus*; E, the line ſeparating

its cavity; F, the *Fundus* or bottom of the *Uterus*; G, two *Sinus's* found in the bottom of the *Uterus*; H H, the thickneſs of the *Uterus*; I I, the *Ligamentum latum*, or the production of the *Peritonæum* on the left ſide, containing in its duplicature, the deferent and ejaculatory veſſels; K, the ſpermatic artery; L, the ſpermati vein; M, the *Teſticulus* or *Ovarium*; N, the true ejaculatory veſſel inſerted into the bottom of the *Uterus*, thro' a *Sinus* found there; O, the other ejaculatory veſſel, which is inſerted into the neck of the *Uterus*; P, the *Tuba Fallopiana*; R, the *Ligamentum rotundum*, or round ligament; S, the *Ligamentum latum* of the falſe *Uterus*; U, the ſpermatic vein; T, the ſpermatic artery; Y, the *Ovarium*; Z, a portion of the *Fallopian* tube; 2, the true ejaculatory veſſel inſerted into the bottom of the *Uterus*, thro' the *Sinus* above mentioned; 3, the other ejaculatory veſſel, running into the neck of the *Uterus*; 4, the part torn by the encreaſed fœtus; 5, the fœtus in that ſituation, in which it was found involved in its amnion; 6, the umbical veſſels; 7, the *Placenta* adhering to a certain fleſhy ſubſtance; 8, that fleſhy ſubſtance; 9, the *Ligamentum rotundum*.

Obſervations concerning the Bath Springs *in* Somerſetſhire; *by Mr.* Joſeph Glanvil. Phil. Tranſ. N° 49. p. 977.

THE country about *Bath* is very hilly and uneven, but the hills lie regular; they are generally rocky, and ſteep from ſouth-weſt and by weſt, to north-eaſt and by north: The whole tract of the country, within five or ſeven miles, abounds with coal mines. But there are no other conſiderable mines nearer than *Mendip*, at ten miles diſtance, excepting ſome of lead at *Berry* in *Glocesterſhire*, which lies to the north of this place, at the diſtance of four or five miles.

The hills for the moſt part afford a free ſtone; and on the north-weſt of *Lanſdown*, the ſtones digged there, are a ſort of hard ſtone, commonly called a *Lyas*, blue, white, and poliſhable.

The town and baths are of very great antiquity: Beſides what is to be found in very ancient chronicles to that purpoſe, one of our great antiquaries Mr. *P.* aſſerts that theſe *Baths* were 800 years before Chriſt.

It is affirmed, that the town for the moſt part is built on a quagmire, tho' the places all about it are very firm ground. Some Workmen, that have been employed in digging, have found a mire ten foot deep, without the north gate; at *Seaven* the higheſt part of the town. The earth between, is a kind of rubbiſh; ſometimes they meet at ſeven or eight foot with oyſter-ſhells.

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The town and circumjacent country generally abound with *cold Springs*: And in ſome places the *hot* and *cold* ariſe very near each other; in one place, within two yards, and in others, within eight or nine of the main baths.

The guides of the *Croſs-Bath* informed Mr. *Glanvil*, that when there is a great weſt-wind abroad, ſtanding by the ſprings, they feel a cold air ariſing from beneath: If the wind be at eaſt, and the morning cloſe, with a little miſling rain; the *Croſs-bath* is ſo hot as ſcarce to be endured, when the *King's* and *hot Baths* are colder than uſual: In other winds, let the weather be how it will, this bath is temperate. The ſprings, that bubble moſt, are coldeſt: The *Croſs-bath* fills in ſixteen hours, both in winter and ſummer, without any difference from heat or cold, floods or drought; that of the *King* in 12 or 14 hours.

A man may better ordinarily endure four hours bathing in the *Croſs-bath*, than 1½ in the others: In the *Queen's-bath*, which has no ſprings of its own, all coming out of the *King's*, they found under a flat ſtone, which upon occaſion was taken up, a tunnel, and a yielding mud in and under it, into which they thruſt a pipe, but could feel no bottom: In the *King's-bath* there is a ſpring ſo hot, that it is ſcarce ſufferable; ſo that they are feign to turn much of it away, for fear of inflaming the bath: The hotteſt ſpring will not harden an egg.

The *Bath* water does not paſs thro' the body like other mineral waters; but if you put in ſalt, it purges preſently: Upon ſettling, it affords a black mud, uſeful in aches, applied by way of cataplaſm; to ſome more ſucceſsfully than the very waters. The like it depoſites upon diſtillation, and no other; nor has any more been diſcovered by all the chymical obſervations he ever knew. One Dr. *Aſtendoff* found, that the colour of the ſalt, drawn from the *King's* and *Hot-bath*, was yellow; that extracted from the *Croſs-bath*, white; and he concluded, that the *Croſs-bath* had more of allum and nitre than the hotter baths, which abound more with ſulphur: And yet the bath relaxes ſhrunk ſinews, by which it ſhould ſeem not to abound much with allum: It is harſher to the taſte than the other baths, and ſoaks the hands more.

A man cannot drink half the quantity of ſtrong drinks in this bath, that he can out of it; but if he have drank before to exceſs, it refreſhes very much: It likewiſe provokes urine.

They are very uſeful in diſeaſes of the head, as palſies, epilepſies, and convulſions; in cuticular diſeaſes, as leproſies, itches, and ſcabs; in all obſtructions of the bowels, as ſpleen, liver,

and meſentery, and in ſchirroſities and hardneſs of thoſe parts; in moſt diſeaſes of women; in the ſcurvy and ſtone; it is alſo good in cold gouts, as they call them; but it has a contrary effect in hot gouts, putting the patients into a fit, if they go into it without preparation; or if they have the fit, it inflames it more, and drives it thro' the body, and ſo diſables the joint, that there is no treading on it: The bath is effectual in diſeaſes of children, particularly, the rickets; it is good for women, that are apt to miſcarry, if uſed moderately: It facilitates delivery: It is beſides very effectual for ſtrengthening broken bones, and good in all cold and moiſt diſtempers, in weakneſs of the nerves, ſtupefactions, relaxations, and violent pains; but it exaſperates venereal pains, except the malignity be overcome by medicines: It is an excellent remedy to remove the remaining weakneſs in gouts, as has been remarkably obſerved in old men.

The *Bath* guides live to a very great age; ſometimes to 100; and ordinarily, if they are temperate, to 70.

In the *Croſs-bath*, the guides have obſerved a certain black fly with ſcaled wings, in the ſhape of a lady-cow, but ſomewhat bigger: They ſay it ſhoots quick in the water, and bites ſometimes: It lives under water, and is never obſerved but in very hot weather; they ſuppoſe it comes up with the ſprings; it is not obſervable any where elſe.

The *Croſs-bath* corrodes ſilver very much: A ſhilling in a week's time has been ſo eaten, that it might be wound about one's finger: The *Baths* agree, as they term it, with braſs, but not with iron; for they will eat out a ring of this latter in ſeven years, whereas braſs rings ſeem to receive no hurt from it.

When women have waſhed their hair with a mixture of beaten eggs and oatmeal, it will poiſon the bath to ſuch a degree, as to beget a moſt noiſome ſmell, caſting a ſea green on the water, which otherwiſe is very pure and limpid; it will taint the very walls, and there is no cleanſing of it, but by drawing the bath.

In ſummer, the baths purge up a green ſcum on the top, but in winter, never; leaving then a yellow on the walls.

The walls in the hot ſprings are very deep laid, and large; 10 foot thick, and 14 deep from the level of the ſtreet: The cement of the wall is tallow, clay, lime, and beaten bricks. In 1659, the *Hot-bath* was much impaired by the breaking out of a ſpring, which the workmen at laſt found again, and reſtored: In digging, they came to a firm foundation of factitious matter, with holes in it like a pumice-ſtone, thro' which the water played; ſo that it is probable, the ſprings are brought together

by art, and not by necromancy as it was anciently believed; for in a very ancient manuſcript chronicle are found theſe words: "When *Lud. Hidibras* was dead, *Bladud* his ſon, a "great nygromancer, (ſo it is there writ), was made king, and "he made the wonder of the hot bath by his nygromancy; "and he reigned 21 years, and after he died, and lies at the "new *Troy*". And in another old chronicle, it is ſaid, "that "king *Bladud* ſent for necromancers to *Athens* to effect this great buſineſs", who, it is like, were no other than cunning artificers, well ſkilled in architecture and mechanics.

It has been obſerved, that leaves, like thoſe of olives, come ſometimes out of the pump of the *Hot Bath*.

The Icy Mountain Gletſcher; *by* M. Muraltus. Phil. Tranſ. N° 49. p. 982.

THE higheſt icy mountains of *Switzerland* about *Valeſia* and *Auguſta*, in the canton of *Bern*, about *Taminium* and *Tavetſch* of the *Griſons*, are always ſeen covered with ſnow; which melted by the ſummer heat, and other ſnow falling in a little time after, is hardened into ice, which by degrees becomes a ſtone, not yielding in hardneſs and tranſparency to cryſtal: Such ſtones cloſely joined and compacted together, compoſe a whole mountain, and that a very firm one; tho' in the ſummer time the country people have obſerved it to burſt aſunder with a great noiſe, like thunder; and theſe cracks and openings prove fatal to hunters, for being by the winds covered with the ſnow, they fall into them and periſh. At the foot of theſe mountains, cryſtals are dug out with great labour, among other foſſils, and are of two ſorts and colours; ſome darkiſh and turbid, by ſome called the cryſtal ore, and found in great plenty in the aſcent of mount *Gotthard*; others tranſparent, very pure, and as clear as *Venice* glaſs, ſexangular, both great and ſmall; and found in the mountains about *Valeſia*, the town called *Urſelen*, and at the foot of the hill *Schelenim*, and ſold at a good rate, one in particular being ſold for 80 pound ſterling.

Obſervations in Japan. Phil. Tranſ. N° 49. p. 983.

THE *Japaneſe* doubt not in the leaſt that their country is an iſland, tho' ſeparated from the continent by ſuch narrow channels, that no veſſel of any conſiderable burden can paſs them.

The air is very healthful, but of a different temperature on each ſide of the mountains, which divide *Japan:* The plague has never been heard of there, tho' the ſmall pox and fluxes are very frequent.

Their mountains are fertile almoſt to the very tops. There you find almoſt all ſorts of *European* fruits, as peaches, apricocks, cherries, prunes, apples, pears, and particularly pippins, bon-chrêtien pears; beſide a vaſt number of other fruits; and generally all the fruits that are to be found in any other part of *India.*

Their ſilver is in the greateſt perfection, but not uſed in trade; in which nothing but gold and ſome ſmall braſs coin is to be ſeen, but they ſpoil their braſs by too much refining; their ſteel alſo is very good.

The temper of their metal was formerly better than it is now; but they ſtill make exceeding good cutlaſhes or ſhort ſwords.

The great mountain of *Japan* is higher than the *Pico* in *Teneriff*, for tho' diſtant from the ſhore above 18 leagues, it may be ſeen above 40 leagues off at ſea; there are 8 vulcano's or burning mountains in *Japan*, and you cannot go any where into the plain, but you may diſcover one or other of them.

They have many medicinal waters and hot ſprings, uſed by the inhabitants in their diſtempers; they have particular medicines; but they never let any blood; they uſe cauſtics very much, applying on ſome nerve or other the powder of *Artemiſia*, or mugwort and cotton, which they ſet on fire; they drink all their liquors warm.

Japan is well ſtored with veniſon, ſo that they have little regard for cattle, tho' they have them in plenty; their oxen are generally employed in ploughing; they make no butter nor cheeſe, nor are they lovers of milk; they have great plenty of corn and rice.

The *Japaneſe* are proper enough in ſtature, and not uncomely in features; their bellies are ſomewhat prominent; they are exceeding active and want no judgment; they are alſo warlike and valiant.

They are maſters of no arts, but what are known in *Europe*, except that of making *Lacca*, of which there is ſome ſo fine and curious, that whereas in *Europe* one may buy a ſmall box for three or four crowns, one of the ſame ſize, and made in *Japan* of exquiſite *Lacca*, will ſell for more than 80 crowns.

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The colours with which they dye their ſtuffs, never fade: This obſerver had ſeen one of them, far exceeding our vermilion and *couleur de feu*; it is extracted out of a flower, like ſaffron, and a pound of it is exceſſive dear; in order to try the durableneſs of the colour, they apply a hot iron to it, and if it holds, they aſſure themſelves of its goodneſs.

There are mathematicians among them; and they are ſo much given to judiciary aſtrology, that the grandees undertake nothing without conſulting the profeſſors of that art.

Japan yields divers ſorts of good ſtaple commodities; but chiefly all ſorts of ſilks, amber, precious ſtones, muſk, copper, ſteel, lack-work.

The country is very populous and exceeding rich, being well ſtored with gold mines; and 10 ounces of ſome gold ore yields 8 of the higheſt fineneſs; and pieces of 120 marks in weight.

Their buildings are very good and commodious, and but of one ſtory high: The ground apartments are ſeparated from each other by partitions of painted and gilt cartoon, to be folded and removed like ſcreens; their floors are covered with mats, and ſometimes with ſtuff of ſilk, embroidered velvet, and cloth of gold.

They have no other conveniences of defending themſelves from heat and cold, than ſuch as are uſual in *Italy* and *Spain*.

They uſe the diverſions of comedy, which are gayer than thoſe of *Europe*; the ſpectators are about 200 paces diſtant from the theatre, which being arched with a vault makes the actors voices to be heard to the very extremity of it; they love hunting and gaming, as dice, cards, cheſs, *&c.* at all times of the day, and in all their viſits they take tea and tobacco.

Their language is entirely different from the *Chineſe*, but their prieſts and courtiers, that is, the learned among them, underſtand the language of *Chochin-China*, and by this means, that of *Tunquin*, *China*, *Corea*, &c. They write neither from the right to the left, nor from the left to the right, but downwards.

Their government is deſpotic; the religion pagan; the chriſtian hated upon no other account, but that ſome of thoſe that profeſſed it there, would perſuade the *Japaneſe* to acknowledge a power ſuperior to the royal dignity, that diſpoſed of crowns and ſcepters. Their morals are very good, their faults are puniſhed as their crimes, even lying and detraction; the left hand is the more honourable, and they take horſe on that ſide.

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A Metalline Burning Concave; *by* M. de Vilette. Phil. Tranſ. N° 49. p. 986.

MR. *De Vilette* of *Lyons*, who made the burning concave of 30 inches diameter, diſpoſed of to the king of *Denmark*, and mentioned before in N° 6. p. 95. has ſince made another of 34 inches diameter, which melts all ſorts of metals, and iron itſelf of the thickneſs of a ſilver crown, in leſs than a minute of time, vitrifies brick in the ſame time, and ſets either green or dry wood on fire in a moment; the king has ſeen it and the performances by it with great ſatisfaction, and his majeſty is likely to purchaſe it for the Royal Academy, for making of further experiments with it.

Theſe kinds of concaves, burning moſt forcibly of any fire we know of, even beyond that of a wind-furnace, would be of great uſe, if they could be ſo contrived as to have a focus of any conſiderable largeneſs, to take in a good quantity of combuſtible matter at once.

The Weight of Water *in* Water; *by* Mr. Boyle. Phil. Tranſ. N° 50. p. 1001.

THE honourable Mr. *Boyle* cauſed to be blown at the flame of a lamp a glaſs bubble of the bigneſs of a pullet's egg, with a ſomewhat long ſtem, turned up at the end, that it might the more conveniently be broken of; this bubble being well heated, to rarify the air, and thereby expel a good part of it, was nimbly ſealed at the end, and by means of the figure of the ſtem, and a convenient weight of lead, it was ſunk in water, after tying both with a ſtring to a ſcale of a good balance, and putting into the other a ſufficient weight to counterpoiſe the bubble, as it hung freely in the water; then with a long iron forceps he carefully broke off the ſealed end of the bubble under water, ſo that no air appeared to eſcape thro' the water, but the liquor by its weight ſpring into the empty glaſs, and filled it half full, and immediately the bubble ſubſided, and made the ſcale, it was faſtened to, preponderate ſo much, that 4 drachms and 38 grains were neceſſary to reduce the ballance to an *æquilibrium*; then taking out the bubble with the water in it, and carefully applying the flame of a candle, he drove out the water, which otherwiſe is not eaſily done, at a narrow ſtem, into a glaſs that was counterpoiſed before, and it was found to weigh about 4 drachms and 30 grains, beſides a little that remained in the bubble; and a little

little that was evaporated, which added to the piece of glaſs that was broken of under water, might very well amount to 7 or 8 grains: By which it appears, that water has not only ſome weight in water, but that it weighs very near, or quite as much in water, as it does in air. He repeated the ſame experiments with another ſealed bubble, larger than the former, and after breaking it under water, it grew heavier by 7 drams and 34 grains; and taking out the bubble and driving out the water into a counterpois'd glaſs, the liquor amounted to the ſame weight, abating 6 or 7 grains, which it might well have loſt on the accounts above.

Obſervations in two Voyages to the Eaſt-Indies; *by* Mr. Rich. Smithſon. Phil. Tranſ. N° 50. p. 1003.

FROM *England* to *Cape Finiſter* in *Gallicia* in 44 °N. Lat. the winds are as variable as with us in *England*; only the bay of *Biſcay* is more ſubject to ſtorms, and the ſea rougher, the waves running very high. From thence to 34° the wind is alſo variable, but if you are within 100 leagues of the *European* continent, it is generally inclined to north-eaſt. From 34° towards the coaſt of *Africa*, or about the meridian of the *Canaries*, the wind is conſtantly at north-eaſt, or within theſe two points, and it is rare to find it otherwiſe: Yet in winter, upon the coaſt of *Africa*, there are ſometimes violent weſterly ſtorms, but of no long continuance; and in ſummer, when it is ſometimes calm, the air will become variable: The north-eaſt wind holds moſt commonly to 8° N. Lat. and then the *Tornado* winds begin, which are for the moſt part confined between 8° and 4° N. Lat. they are ſeldom or never more ſoutherly; but on this ſide the *Line*, they have ſometimes been met with between 11° and 12° N. Lat. and ſometimes in 9° and 10°. Theſe *Tornado*'s are uncertain winds, blowing from all points of the compaſs in the ſame hour, and ſometimes the wind ſhifts thus without intermitting, and at other times it will be quite calm, between every blaſt: And they are ſo irregular, that if 4 or 5 ſhips ſail as near each other, as ſhips well can, in the ſame inſtant, very often, each ſeveral ſhip will have a ſeveral and contrary wind. This place is generally infeſted with dreadful thunders, lightnings and rain: And the nearer you are to the *African* ſhore, ſo much the more dreadful is the thunder and rain; but the further weſtward you go, the thunder and rain will be the leſs, and the winds not ſo uncertain; ſo that, if you go as far weſt, as the meridian of the eaſt ſide of *Braſil*, there

there is little thunder, nor does the wind come down in ſuch puffs and flaws; but between 4° and 8° it is moſt inclined to calms, and very great and thick fogs; but the rains fall not in ſuch violent ſhowers: This is a certain rule that near the *African* ſhore, and ſo for 100 or 200 leagues to the weſt of it, the north eaſt winds commonly incline more and more to the eaſt; ſo that when you come to the weſt of the meridian of the *Azores*, about 20°, the trade or conſtant wind will be generally E. N. E. Now as from 34° to 44° near the continent of *Europe*, the winds are commonly between eaſt and north, ſo after you come ſo far weſt as the meridian of the hithermoſt of the *Azores*, they are commonly between S. W. and N. W. and, for this reaſon, ſhips that are outward bound to the *Straights*, keep near the coaſt of *Portugal*, but homeward bound, they are often forced to run far weſt to fetch a weſterly wind: Likewiſe ſhips, bound to *Barbados*, go by the *Canaries*, but come home a great way to the N. W. of the *Azores*: And the *Virginia* ſhips are twice as long in going out, as they are in coming home, and often, longer; for, they come home directly before the wind, but go out round about as far as the *Tropic*, or at leaſt to 28° latitude, for the benefit of the N. E. wind; and when that has carried them far weſt, they come back to the northward again; and then, as the weſterly wind hangs more or leſs ſoutherly, they have a good or bad paſſage: Between 3° or 4° N. Lat. the ſouth eaſt wind begins to take place between the *Equator* and *Tropic* of *Capricorn*; but the nearer you are to the coaſt of *Africa*, it is ſo much more ſoutherly, and as you approach the coaſt of *Braſil*, it inclines more and more eaſterly: And there is not only a variation in the wind in reſpect of longitude, but alſo in reſpect of latitude; for, near the *Equator*, the wind is more ſoutherly, than it is in the ſame meridian near the *Tropic* of *Capricorn*; as for inſtance, in the great *Bay* of *Guinea*, which our ſeamen call the *Bight* of *Guinea*, the wind is generally ſouth; and inclines as much to the weſt, as to the eaſt; but in the ſame meridian near the *Tropic* of *Capricorn*, it is conſtantly between S. E. by E. and S. E. by S. and on the contrary, in that meridian, which may be about 100 leagues to the eaſtward of *Braſil*, near the equator, the wind is between ſouth-eaſt and E. S. E; and in the ſame meridian, the winds near the *Tropic* are more variable, but commonly about north eaſt.

In his latter voyage from the *Line* to the *Tropic* of *Capricorn*, he had many calms, and what winds he had were very ſmall

ſmall, which was in the latter half of *April* and former half of *May*; but in his firſt voyage, in the latter half of *May* 1657 he had great ſtorms: The ſtormy days were *May* 16, 17, 18, and eſpecially the 17th in 7° S. Lat. Likewiſe the 20th, and 21ſt in the latitude of 12° and 13° and the 27th at night, in 22° S. Lat. which was the moſt ſudden and unexpected he ever obſerved; for all day it was very fair weather, and ſo till 8 at night, and the wind at north-eaſt, but on a ſudden came a violent ſtorm of wind at ſouth-weſt, and in a moment the whole heavens were become black and prodigiouſly dark, which continued till 4 next morning, with intolerable rain; and then the wind came again to N. E. and it was preſently fair.

Near *Africa*, the ſouth-eaſt winds hold to 28° or 29° S. Lat. but towards *Braſil* from the *Tropic* of *Capricorn* to 32°, they are variable, and to the ſouthward of 32° weſterly.

Conſiderations on the Variety of Slate, *and a Computation of the Charges of covering* Houſes *with them*; *by* Mr. Sam. Colepreſs. Phil. Tranſ. N° 50. p. 1009.

AMONG the ſeveral materials for building, that for covering houſes, is not the leaſt to be regarded; in particular, our country ſlate ought not to be deſpiſed, either for beauty, duration or cheapneſs; the firſt appears, from the ſlated houſes in and about *London*; for the ſecond, the moſt experienced *Helliers* or ſlaters affirm, that ſome ſorts have laſted on houſes for ſeveral 100 years, and continued as firm, as when firſt put on; and as to the third, the following calculation may give ſome hint of the charges.

In order to know the goodneſs and durableneſs of any ſlate, take and ſtrike it againſt any hard body, and if the ſound be diſtinct and clear, then it is firm and good: Or if in hewing, it does not break before the edge of the *Sects*, the ſlater's hewing inſtrument; but if, after being exactly weighed, you put it for ſome hours under water in a veſſel, and afterwards, take it up, and wipe it very clean, it weigh more than before, then it is of that kind, which imbibes water, and therefore not ſo good, becauſe it will rot the lathes and timber; and their texture may alſo be gueſſed at, by their colour, for deep blackiſh blue are apteſt to take in water; but the lighter blue are the firmeſt and cloſeſt; beſides, a good ſtone feels ſomewhat hard and rough; whereas an open ſtone feels very

ſmooth, and, as it were, oily: For further trial, put a ſlate by the length perpendicularly in the middle of a veſſel of water, no matter how ſhallow, ſo it exceed half a foot, and be ſure not to wet the upper unimmerſed part of the ſlate, and let it continue for a day or ſo; if it be a good firm ſtone, it will not draw water half an inch above the level of the water, and that perhaps at the edges only, the parts of which might be ſomewhat looſened in the hewing; but a bad ſtone will draw water to the very top.

As for the charges of covering houſes with ſlate, they may be thus computed.

	s.	d.
1000 Efford ſmall blue, at the ſhip's ſide in *Plymouth* harbour. — — — — — — — —	5	6
1000 Efford large blue. — — — — — —	9	9
1000 Can pelmel. — — — — — — —	7	0
1000 Of ſmall blue, of other quarries. — — —	4	0
1000 Of large blue. — — — — — — —	8	0

3000 Of ſmall blue are accounted two tuns in carriage by water; 1000 of large blue, one tun; 3000 of ſmall will cover one pool of work at the fifth pin plain; every pool of work is either ſix foot broad, and fourteen foot up, on both ſides; or 168 foot in length, and one in breadth; 3000 of large will cover two pools of plain work.

	s.	d.
Hewing of all ſorts of plain pelmel *per* 1000. — —	1	6
Pinning *per* 1000, 8 *d*; pins per 1000, 8 *d*. — —	1	4

Three buſhels, *Wincheſter* meaſure, of good lime, will take ſix buſhels of freſh water ſand; and ſerve to lay on one pool of work, tho' leſs may do; 300 lathes to every pool of work; 1000 lath nails to every 300 laths.

An able workman may { lath one pool of work / lay on 2000 or more of ſlate / hew 1500 plain / pin 4000 } by the day.

Checquer-work conſiſts in angles, circles, and ſemicircles, &c. which requires an uncommon ſkill, and time in hewing and laying.

It is worth obſerving, that if a ſide-wall happen to take wet, by the beating of the weather, *kerſing* with ſlate will cure it, when nothing elſe will.

Obſer-

Observations on the odd Turn of some Shell-snails, *and the darting of* Spiders. Phil. Transf. N° 50. p. 1011.

THERE are two sorts of shell-snails easily distinguishable from each other, and from all besides; because, the turn of the wreaths is from the right to the left hand, contrary to what may be seen in common snails; they are very small, and might therefore well escape thus long the more curious naturalists; as not much exceeding a large oaten-corn: The aperture of the shell of the first sort is pretty round, the second turn or wreath is very large, and the rest of the wreaths, about six in number, are still lessened to a point; this conical figure is near a quarter of an inch; the colour of the shell is duskish, but when the animal is shrunk in it, it is transparent, and then it is of a yellow colour: These shells are extremely brittle and tender: The second sort seem to be stronger and thicker, they are near half as long as the other, and quite as slender; exactly resembling an oaten-corn, being pointed at both ends, and the middle a little swelled; the aperture of this shell is not exactly round, there being a peculiar cavity in the lower part thereof; they have about ten spires or wreaths that turn from right to left; its colour is of a dark and reddish brown. When the snails creep, they raise the point of their shells to a perpendicular, and exert, with part of their body, two pair of horns, as most of their kind do: In *March* they are still to be found in pairs; but whether the one be male, and the other female, or both male and female, and both receive and emit a *Penis*, as seems probable on separating them, must be left to further enquiry. Among the *Romans*, they were looked upon as the most delicate food, and they were very careful, according to *Varro*, in breeding and fattening them for their tables; tho' their relish is none of the most agreeable; and *Petronius Arbiter* relates, that they used these animals, and in particular their necks, *Cervices cocklearum* in which the *Penis* is lodged, as well as truffles, mushrooms, and the *Cossi*, or great worms in oaks, to excite venery: These snails are found frequently enough under the loose bark of trees, as old willows, and in the clefts of elms, oaks, *&c.* and no where else, that could be observed.

All spiders, that spin a thread, those called *Shepherds* or long-legged spiders never do, produce those threads observable in the air in summer, and especially towards *September:* Upon carefully observing one that wrought a net, he suddenly stopp'd in the middle of his work, and turning his tail to the wind, he darted out a thread, with the violence water is observed to spout out of a

ſpring; this thread, being taken up by the wind, was emitted ſome fathoms in length out of the animal's belly; and immediately the ſpider leap'd into the air, and the thread mounted him up ſwiftly: He afterwards obſerved the air full of young and old ones, ſailing on their threads, and doubtleſs ſeiſing gnats and other inſects in their paſſage; there being often manifeſt ſigns of ſlaughter, as wings, legs, *&c.* of flies on theſe threads, as in their webs below: The threads that came down out of the air, were not ſingle, but ſnarled, and with complicated woolly locks; whereas, when they firſt flew up, the thread was ſingle: He obſerved them getting to the top of a ſtalk or bough, where they dart their threads into the air; and if they had not a mind to ſail, they either wound it up again with their fore-feet over their heads into a lock, or they broke it off ſhort, and let the air carry it away: After the firſt flight, all the time of their ſailing, they make locks, ſtill darting forth freſh ſupplies of thread, to ſport and ſail by: It is to be obſerved, that theſe complicated threads are more tender than our houſe-webs: In winter, eſpecially at *Chriſtmas*, they are obſerved to dart, but few of them ſail then, and therefore, only ſingle threads are to be ſeen; and they are the young ones of the preceeding autumn that are then employed; and it is more than probable, that the great ropes in autumn are made by the great ones alone, on long paſſages when great numbers of prey invite them to ſtay longer up in the air.

The Way of making Salt *in* France. Phil. Tranſ. N° 51. p. 1025.

AA A (Plate VI. Fig. 5.) is the ſea, 1 1 the inlet for the ſea-water into B B, the firſt receptacle, in which the water is kept 20 inches deep; C C C the ſecond receptacle, where the water, as you ſee, makes three turnings, and is ten inches deep; 2 2 the opening, by which, the firſt and ſecond receptacles communicate; E E F the third receptacle, properly called the mariſh; *d d d d d d* a narrow channel, thro' which the water muſt paſs, before it goes out of the ſecond into the third receptacle; 3 3 is the opening, by which the water runs out of the ſecond into the third receptacle; the prick'd lines in the ſcheme, mark the courſe and turnings the water is forced to make, before it comes to *h h h h h*, the beds where the ſalt is made; and in them, the water muſt not be above an inch and a half deep; each of theſe beds is 15 foot long, and 14 broad; 9 9 9 9 9 are the little channels between the beds; 8 8 8 8 8 are the apertures, by which the beds receive the ſea-water after many windings and turnings: When it rains, the openings 2 2 and 3 3 are ſtopp'd, to hinder the water from

running into the mariſh marked E E F; unleſs it rain much, the mariſh is little hurt by rain water, even tho' it rain for 24 hours, and not above an inch high, the heat of the ſun being ſufficient to exhale it, without letting it run out; only if it rain plentifully, no ſalt is drawn for three or four days following; but if it rain for five or ſix days, then all the water of the beds muſt be emptied by a channel conveying it into the ſea, which cannot be opened but at low water: The hotteſt years make the moſt ſalt, beſides what the wind contributes; for leſs ſalt is made in calm, than in windy weather; the weſt and north-weſt winds are the beſt for this purpoſe: They draw ſalt every other day, and out of the beds *h h h*, at each time more than 100 pound weight of ſalt; in the hotteſt ſummer ſeaſon, it is made even in the night time; the inſtruments uſed to draw the ſalt, have many ſmall holes, to let the water paſs, and retain nothing but the ſalt; according to the quality of the earth of the mariſh, the ſalt is more or leſs white; reddiſh earth makes it more gray; the blueiſh more white; and if you let in more water than you ought, the ſalt is whiter; but then it yields not ſo much: Generally the mariſhes require fat earth, neither ſpungy nor ſandy: Three things are neceſſary to the whiteneſs of ſalt; firſt, that the earth of the mariſh, be fit for it; ſecondly, that the ſalt be made with a great deal of water; thirdly, that the ſalt-man, who draws it, be dextrous: In the iſle of *Rhé*, there are men that draw it as white as ſnow; and ſo it is in *Xaintogne*; care is to be taken, that the earth at the bottom of the beds mingle not with the ſalt; that uſed at table is perfectly white, owing to this, that four or five hours before the ſalt is to be drawn, they draw the cream, or the ſalt formed on the top of the water; its grains are ſmaller than thoſe of the other: Generally the ſalt of *Xaintogne* is a little whiter than that of the iſle of *Rhé*, which laſt is of the ſize of a pepper-grain, and of a cubical figure: The mariſhes are preſerved from one year to another, by overflowing them a foot high: Some mariſhes are only ſeparated from the ſea, by a ditch 20 or 30 foot wide; others are at a greater diſtance; receiving the water by channels, made according to the ſituation of the mariſhes; the ditch is paved with ſtones from top to bottom; the timber of the mariſhes, if of good oak, keeps near 30 years; but they uſe but little wood, all the ditches and apertures being built with ſtone.

Of

Of the Eruptions of Mount Ætna, Anno 1669; *communicated by some* Engliſh *Merchants.* Phil. Tranſ. N° 51. p. 1028.

ABOUT 18 days before it broke out, there was a very thick dark ſky, with thunder and lightning, and frequent concuſſions of the earth; and it was obſerved, that the old top or mouth of mount *Ætna* for two or three months before, raged more than uſual, as alſo *Volcano* and *Strombilo*, two burning iſlands to the weſtward. It firſt broke out on *March* 11th, 1669, about two hours before night, on the ſouth-eaſt ſide of the mountain, about 20 miles below the old mouth, and ten miles from *Catania*; at firſt it was reported, to advance three miles in 24 hours; but *April* 5th, it ſcarce moved a furlong a day, and after this manner it continued for 15 or 20 days, paſſing under the walls of *Catania* a good way into the ſea; but about the latter end of *April* and beginning of *May*, it bent all its force againſt that city, and paſſed over the walls in ſeveral places; but its chief fury fell on a convent of *Benedictines*, with large gardens between it and the wall; after filling of which ſpace, it met with ſtrong reſiſtance from the convent, which made it ſwell very high; ſome parts of this wall were driven in, whole and entire, almoſt a foot; but here its fury ceaſed the fourth of *May*, running afterwards in little ſtreams into the ſea; it had overwhelmed in the inland country about 14 towns and villages: The matter of theſe ſtreams was nothing elſe, but divers kinds of metals and minerals liquefied by the fierceneſs of the fire in the bowels of the earth, boiling up like water at the head of ſome river; and running a little way, the extremities began to cruſt and curdle, turning when cold, into thoſe hard porous ſtones, commonly called *Sciarri*, nearly reſembling large cakes of ſea-coal, full of fire; they came rolling and tumbling, one over another, and when they met with a bank, would fill up and ſwell over, by their weight bearing down any common building, and burning what was combuſtible; its chief motion was forward, but it would alſo dilate itſelf, like a flood of water on a level, throwing out ſeveral arms, or tongues, as they call them: About two or three o'clock, theſe obſervers went up to a high tower in *Catania*, whence they had a full view of the mouth; a dreadful ſight to ſee ſuch a maſs or body of fire! they would, next morning, have gone up to the mouth itſelf, but durſt not approach nearer than a furlong, for fear of being overwhelmed by a ſudden turn of the wind, which carried up into the air ſome of that vaſt pillar of aſhes, higher and bigger than St. *Paul's* ſteeple;

ſteeple; the whole air round about, was covered with the lighteſt of thoſe aſhes, blown off from the top of the pillar; and from the firſt eruption till it ceaſed, which was 54 days, neither ſun nor ſtars were ſeen; from the outſide of this pillar, great quantities of ſtone fell off, but none very big; at the mouth, whence the fire and aſhes iſſued, there was a continual noiſe, like the beating of great waves againſt rocks, or like thunder at a diſtance, it was ſometimes heard 60 miles off, and ſometimes 100, to which diſtance the aſhes have alſo been carried; and ſeveral ſeamen affirmed their decks had been covered with them at *Zant*: About the middle of *May*, three quarters of the city of *Catania* was ſurrounded with theſe *Sciarri*, as high as the top of the walls, and in many places they broke over; the ſurface of theſe *Sciarri* are rugged, lying together in great flakes; their colour is of a dark duſky blue. The whole country, from the walls of *Catania* for twenty miles is full of thoſe old *Sciarri*, which former eruptions threw up, tho' the people remember none ſo big as the laſt, or that burſt out ſo low; this country is notwithſtanding well cultivated and inhabited; for length of time has either mollified many of thoſe old *Sciarri*, or they are covered by new mould or aſhes; tho' there ſtill remains much ground, which may poſſibly be never made ſerviceable.

An Account of ſeveral Minerals *thrown up by the late Eruption of* Ætna. Phil. Tranſ. N° 52. p. 1041.

A Careful examination of the matter thrown up by vulcano's, may greatly conduce to a rational account of theſe eruptions; for if it be found of an inflammable nature, it may ſoon be kindled by ſome falling ſtones, which breaking in pieces, may ſtrike fire, and ſo inflame ſuch combuſtible materials. Upon examining the aſhes, taken up in ſeveral places about mount *Ætna*; ſome at the top or mouth, ſome a mile off, ſome four, ſome ten miles, ſome but half a mile, and others on the ſkirts of the new made mountain; the four firſt were found very dry, like duſt, but the two latter very moiſt; and theſe two differ from each other, in that one ſort conſiſts of hard and ſmall lumps, the other, of very ſoft dirty grains, yet both moiſt, and of a vitriolic taſte: Upon examining the cinders, called *Sciarri*, ſome were obſerved to be coarſer, taken up at ſome diſtance from the mouth; and of theſe, ſome were black, with a cruſt of brimſtone, and ſome of a red hue; others were finer, ſaid to be taken out of the gutters of fire, at the very mouth; both theſe ſorts are light; but there is a third ſort of ſtone, very ſolid and ponderous, which

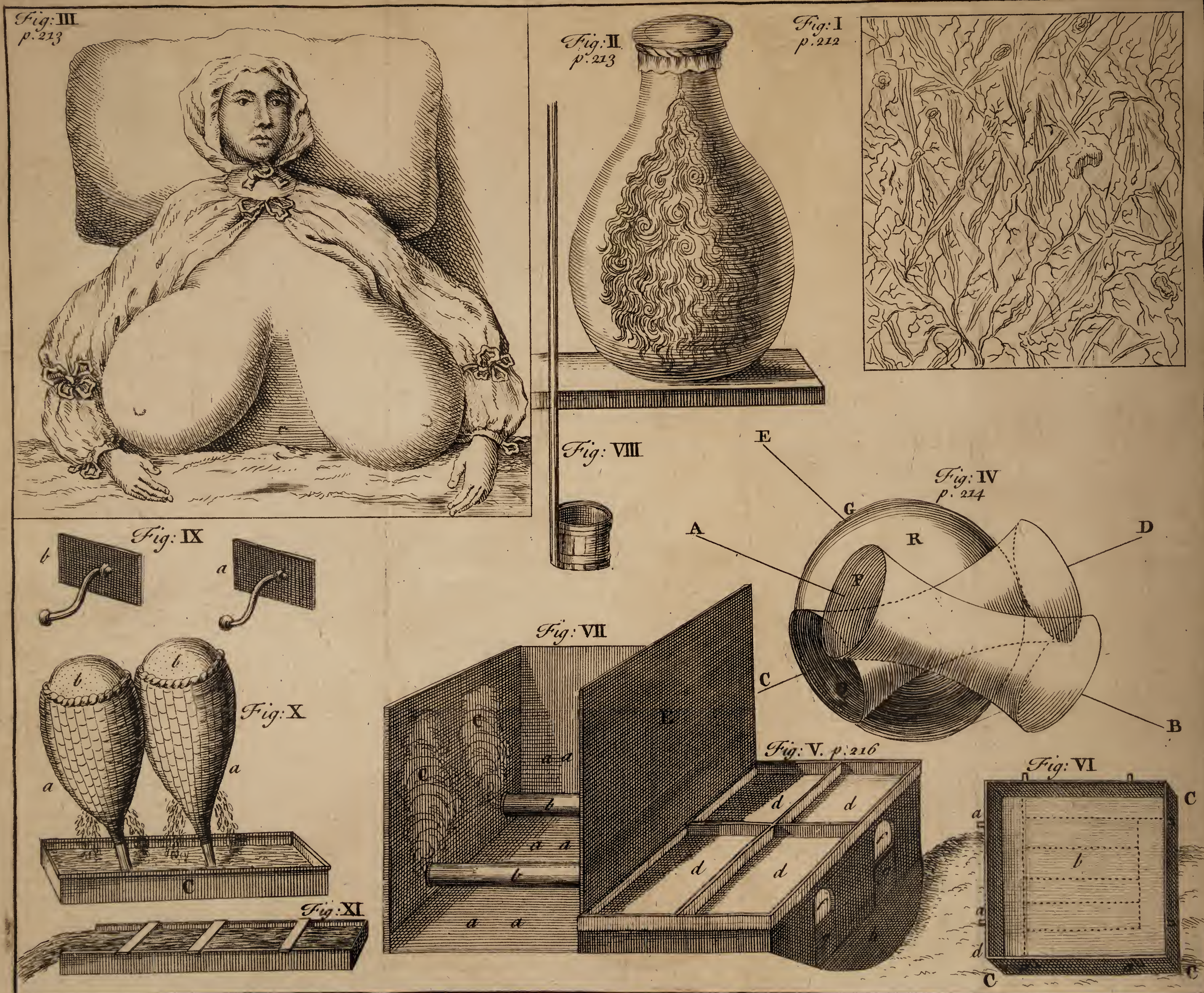
ſeems

ſeems to conſiſt of ſeveral minerals melted together: The third thing that was examined, was a piece of ſal-armoniac and ſeveral pieces of ſandiver.

This eruption was obſerved to ſpread three miles in breadth, and ſeventeen in length.

Obſervations on the Organs *of* Generation; *by Sir* Edm. King, *and M.* De Graeff. Phil. Tranſ. N° 52. p. 1043.

SIR *Edm. King* found the veſſels of the *Teſtes* of rabbets to lie in round folds, like little inteſtines; but both ends of each roll to meet at their inſertion, which ſeems to be made into the *Ductus nervoſus*; and that each of theſe little rolls is curiouſly embroidered with other veſſels, which from their reddiſh colour, even to the naked eye, ſeem to be veins and arteries; theſe little rolls, he obſerves to lie in ranges, not unpleaſant to the eye in a good light; and that they are not one entire tube, but conſiſting of many tubes, beſides the embroidery of veins and arteries; for, upon cutting one of theſe rolls tranſverſely, there appeared five, ſix, or more diſtinct tubes in one roll, and contained in one common membrane; but their texture is ſo fine and tender, that they will not admit of expanſion, like other *Teſtes*, and eſpecially, as thoſe of a rat are ſaid to do by *De Graeff*: He examined the *Teſtes* of a bull, and ordered them ſeveral ways, ſome he boiled, others he broiled, others he infuſed in ſpirit of wine, hot and cold, and he obſerved all to be either veſſel or liquor, as he had formerly aſſerted in N° 18. that there is no ſuch thing as a *Parenchyma* to be found in the bodies of animals: He alſo diſſected the *Teſtes* of men, wherein he found nothing elſe but a congeries of veſſels of ſeveral ſorts, and their various liquors: Fig. 1. Pl. VII. repreſents the *Teſtes* of a man, after removing the *Tunica albuginea*, expanded on a glaſs; and if it ſhould be objected, that this may be drawn out into ſeeming veſſels, which yet in reality are not ſuch; he anſwers, that theſe veſſels have the ſame appearance in the body of the *Teſtes*, as to denote them ſuch, before they are drawn out; and one of them will eaſily extend near a yard long, before it breaks, tho' ſo very delicate and tender; and when thus extended, it reſembles the corrugations of the *Epididymis*; and that the greateſt part of theſe veſſels are arteries, or other veſſels, which immediately receive liquors from them; he proves by an injection into a part of the *Arteria preparans*; for, upon opening the part, which was diſcoloured, he found that many of theſe tubes had received ſome of the fine particles of that matter, with which the injected ſpirit was tinged. M. *de Graeff* confirms this



G. Smith del. E. Bowen Sculp

this doctrine, *viz.* that the *Testes* of animals consist of nothing but vessels and their liquors; and Fig. 2. is the testicle of a rat prepared after his manner.

A sudden and excessive Swelling *of a* Woman's Breasts; *by Dr.* W. Durston. Phil. Transf. N° 52. p. 1047.

ELizabeth *Trevers*, aged 23 or 24, of a fair complexion, and of a healthy constitution, was on *July* 3d, 1669, in good health, and slept well that night; but in the morning, when she awaked, and attempted to turn herself in the bed, her breasts were swelled to such a degree, and became so heavy, that she could not stir; yet without any pain or weakness in her breasts or any other part. Dr. *Durston* advised the use of an emollient warm *Fotus*, and once he gave a *Bolus*, which wrought ten times downwards, and the swelling abated a little; but she was so weakened by it, for two or three days after, that he durst not attempt to repeat it; but on account of the suppression of the *Menses*, he prescribed some diuretics and emmenagogues: The *Tubuli*, or pipes of the breasts, were very hard, and indeed the whole breasts seemed to be nothing more than those *Tubuli*, and with little or nothing of wind or water; the left breast weighed, as near as could be guessed, about 35 pounds, but the right somewhat less; and the skin of the back, neck, and belly seemed to be drawn towards the breasts, to serve for the distension: Fig. 3. Pl. VII. the circumference of the right breast was 2 foot, 7 inches; of the left, 3 foot 1 ½ inch; the length of the right breast from the collar-bone 1 foot 5 ½ inches; the length of the left breast 1 foot 7 ½ inches; the breadth of the right breast, 1 foot 1 inch; and that of the left, 1 foot 4 ½ inches.

About the beginning of *September*, she coughed up at several times some blood, but this was soon taken off; and at that time there appeared several cutaneous ulcers on her breasts, and other parts, especially a great many on the *Pudenda*, which last were cured; but those on her breasts remained in part, and discharged a great deal of matter, by only applying colwort leaves: She complained of grievous pains in her joints, especially on the *Tibiæ*; whereupon he applied *empl. de ran*, and gave her, for three succeeding mornings, a dose, which the third day wrought upwards and downwards, pretty briskly; after which her pains, and many of the ulcers vanished, and her breasts were much less; but she died *October* 21st: Next morning cutting off her left breast, it weighed 64 pound weight; and on opening it, there was found neither water, cancerous humour, nor any other thing, more than

its extraordinary bulk; the *tubuli*, and parenchymous flesh were white and solid, and no other than what is observed in the soundest breasts of women or udders of other animals: She had lost her stomach, and could not sleep for several weeks before, she complained much of her breasts from their great distension, and her whole body was exceedingly emaciated; the breadth of her two breasts, was 3 foot 2 ½ inches, their circumference length-wise 4 f. 4 in. and the circumference of the breadth 3 f. 4 ½ in. the right breast was not cut off, but it was supposed to weigh 40 pounds.

A Description of Sir Christ. Wren's *Engine for Grinding Hyperbolical* Glasses. Phil.Transf. N° 53. p. 1059. *Translated from the* Latin.

LET there be three bodies, P, Q, R, Plate VII. Fig. 4. fit for grinding; of which let P and Q be equal, and of the shape of a pillar, and R resemble a lens; let P be turned round the axis A B; Q, round C D; and R, round E G: Let A B and C D be in different planes, but so posited that E G, being produced, may be at right angles both to A B and C D; and in fine, let the bodies approach to each other, as will be found necessary; still observing the same situation and position of their axes: I say, that by the rotation and mutual attrition of these bodies, new geometrical ones will arise, of which P and Q will be equal hyperbolical cylindroids, and R an hyperbolical conoid given both in species and magnitude.

Both the demonstration, and the model of the machine itself for grinding hyperbolical glasses is very plain; to give a figure of it, and to describe it minutely, would cause more trouble both to the artist and myself than the inventing of it; for since the geometrical principles are already explained, it will be easy to guess at the instrument; *viz.* three oblong, plain, strong, and smooth boards are laid upon each other; the lowest and middlemost sustain the unequal supporters (or handles supporting the mandril) placed alternately, this is necessary on account of the obliquity and decussation of the two mandrils; the poppet-heads or supporters disposed according to the length of the uppermost board are equal to it, and the mandril is inserted into a perforation in the nearest poppet-head. I omit the several wheels, pullies, strings, weights, screws and the apparatus necessary for fixing the machine and giving it a swift motion: P, belongs to the lowest board; Q, to the middlemost; R to the uppermost; R is a lens of glass;

glaſs; Q, a grinding tool that grinds the lens; P, the director correcting the grinding tool, which moving obliquely and with a direction different from that of the lens and grinding tool, continually effaces and grinds off any defect communicated to the grinding tool by the attrition of the lens, and its own matter: Wherefore, ſince the formation of the hyperbolical conoid is ſo ſimple and eaſy, ariſing only from circular motions, and that the motion is twofold and in different directions, it is probable, that hyperbolical glaſſes muſt be deriv'd from theſe principles or none.

Salt Springs *and the making of* Salt *at* Nantwich *in* Cheſhire; *by* Dr. Jackſon. Phil. Tranſ. N° 53. p. 1060.

THE depth of ſalt ſprings is various, in ſome places not above 3 or 4 yards; at *Nantwich* the pit is full 7 yards from the footing about the pit, which is thought to be the natural height of the ground, tho' the bank be 6 foot higher, accidently raiſed by the rubbiſh in making ſalt, or *Walling*, as they call it; in other places the ſprings lie much ſhallower; in two places they break up in the meadows, in ſuch a manner as to fret away not only the graſs, but part of the turf, ruſhes alone maintaining their ſtation, and the ſalt liquor ouſes gently out of the mud. The country round about is generally low ground, as appears from the name given it, *viz.* the *Vale Royal* of *England*; yet it is full of ſeveral eminences and riſings: In this country there is a peculiar ſort of ground called *Moſſes*; a kind of mooriſh boggy ground, very ſtringy and fat, which ſerves for turf, cut out like great bricks, and dried in the ſun: In thoſe moſſes is found much of that wood called *Fir-Wood*, which the country people uſe for candles, fewel, and ſometimes for timber, and are popularly thought to have lain there ſince the flood.

The ſprings are about 30 miles from the ſea, and generally lie all along the river *Weaver*: The water is ſo very cold at the bottom of the pit, that when the briners go ſometimes to cleanſe it, they cannot continue above half an hour in it, and in that time they drink much ſpirituous liquors; there are no hot ſprings nearer than *Buckton-well*, about 30 miles diſtant.

Springs are rich and poor in a double ſenſe; for a ſpring may be rich in ſalt, but poor in the quantity of brine it affords; thus they have rich brine in their chief pit at *Middlewich*, which yields a fourth part of ſalt; but its brine is ſo ſcanty, that the inhabitants are limited to their proportions out

of it, and their quantity is supplied out of pits that afford a weaker brine.

The pit at *Nantwich* yields about a pound of salt to six pound of brine, and it is sufficient to supply 50 *Wich Houses*, never falling much lower than a yard or two at most; the more the pit is drawn, the brine is the stronger, which seems to arise from the salt springs coming quicker, and the less time allowed for the admission of fresh-water; and they make more salt of the same quantity of brine in dry than in wet seasons.

They formerly boiled their brine in six leaden pans, in one house, with wood-fires, but these are changed into four iron ones, *d d d d* (Plate VII. Fig. 5.) something better than a yard square, and about six inches deep; and many have changed the four into two greater iron pans; their fuel is pit-coal from *Staffordshire*; the pans are set upon iron-bars, and made in very close on every side with clay and bricks: They first fill their pans with brine out of the pit, which runs in several wooden gutters, and then they pour into each pan, holding about 360 quarts of brine, two quarts of a mixture, made of 20 gallons of brine, and two quarts of calves, cows, or chiefly sheep's blood; upon the first boiling, the pan throws up a scum, which they take off with a skimmer, called a *Loot*, here they quicken the fire, till half the brine be wasted; and this they call *boiling upon the fresh*; but when it is half boiled away, they fill their pans with new brine out of the *Ship*, which is a great cistern, into which the brine runs thro' the gutters from a pump that stands in the pit; then they thoroughly beat a quart of whites of eggs with the same quantity of brine, and mix them with 20 gallons of brine, and thus they make what is called the *Whites*; after this they boil sharply, till the second scum arise, which they take off as before, and then boil very gently, till it granulate or corn; to promote which, they put into each pan, about a quarter of a pint of the best and strongest ale they can get, this makes a momentary ebullition, and then they lessen their fires, keeping it gently boiling, called *boiling on the leach*, because then they lade in their *Leach-brine*; for the workmen say, if they boil fast here, it wastes their salt; after all their *Leach-brine* is in, which is the brine that runs from their salt, when it is taken up before it hardens, they boil gently till a kind of scum, like a thin ice, arise; and this is the first appearance of the salt; then that sinks, and the brine granulates with it at the bottom, which

which they gently rake together with their *Loots*, for fear of breaking the corns; and this they continue doing, till there is very little brine left in the pan; then they throw the ſalt with their loots into barrows, which are caſes made of flat cleft wickers, in the ſhape of a ſugar loaf, the bottom uppermoſt, and ſo let it ſtand for an hour and an half over the trough, where the *Leach-brine* drains off, then they remove it into the hot-houſe behind their works, by two tunnels under the pans; the *Leach-brine* from the barrows is put into the next boiling.

The ſmaller pans being ſhallower, boil their brine in two hours; and their ſalt will laſt better, tho' it does not granulate ſo well, for the fire and the ſtirring breaks the corns; but it weighs heavier and melts not ſo ſoon; the greater pans, which are uſually deeper, are half an hour longer in boiling; but becauſe their ſalt is taken out of the brine, and hardened only in the *Hot Houſe*, it is apter to melt away in a moiſt air, that the bigger the grain is, the longer it laſts, and generally this is the better granulated and the clearer, tho' the other be the whiter; upon which account, it ſhould ſeem, that taking the ſalt out of the brine before it is waſted, rather than the ale, promotes the granulation. The pans are never covered all the time of boiling; their houſes are like barns, open up to the thatch, with a *Louver-hole* or two for the ſteam of the pans to get out: This ſalt preſerves both beef and bacon very well for a whole year, and ſeems to be more penetrating than the *French* ſalt.

Grey Salt, is the ſweepings, which being ſcattered about on the floor, gather much dirt.

Cats of ſalt are made of the worſt of ſalt, wet from the pans, mixed with cummin-ſeed and aſhes, moulded and baked into a hard lump in the mouth of an oven, this is only uſed for pigeon-houſes.

Loaves of ſalt are the fineſt ſalt; there is no difference in the boiling of theſe from the common way of boiling the fine ſalt; the barrows deſigned for *Salt Loaves* are cut with a long ſlit from top to bottom equally on each ſide, then both ſides are tied together with cords, the barrow filled with ſalt, boiled as uſually, and rammed down with a wooden bar, after which, they put it in the *Hot Houſe*, where it ſtands all the time of their *Walling*, then they take out the loaf, and untie the cords that faſten the barrow, that it may open without breaking the loaf, which they bake twice or thrice in an oven, and keep in a ſtove or chimney-corner in a caſe of cloth or leather, and when

when they have occaſion to uſe any, they ſhave it off with a knife, like ſugar.

Fig. 6. Plate VII. repreſents the model of an iron pan, when four are uſed in one houſe; *aa* the ears to hang the pan by; *b*, the ſeveral joinings of the iron plates riveted; C C, the breadth and length of the pan, about four foot; C*d*, the depth of the ſides of the pan, about ſix inches Fig. 7. *aa*, the hot houſe between the wall and the chimney; *bb*, the two tunnels; C C, the chimney-back, into which the two tunnels convey the ſmoke; *dddd*, the four pans; E the partition-wall between the pans and the hot-houſe; *f*, the fire-places; *gg*, aſh-holes; *h*, the hearth below; *ii*, the deſcent to the hearth; Fig. 8. the back with his ſtale, with which they reach brine out of their ſhip to fill their pans: Fig. 9. *a*, *b*, ſeveral poſitions of their loots, with which they ſkim and gather their ſalt; Fig. 10. *aa*, two barrows filled with ſalt, ſet into the leach-trough to drain off the brine; *bb*, the ſalt heaped above the barrows and patted hard down; C, the leach-trough: Fig. 11. a gutter, laid from one pan to another, to pour the brine into the fartheſt pans.

The Quickſilver Mines *in* Friuli; *by* Dr. Edw. Brown Phil. Tranſ. N° 54. p. 1080.

THE ſituation of *Idria*, a town in the county of *Goritia* and province of *Friuli*, is low, and encompaſſed on all ſides with hills; a river of the ſame name runs by it, which proves ſufficient, after plentiful rains to convey down the fir-trees and other timber for the ſervice of the mines, either for building or fuel; and there are piles drove ſloping a-croſs the river, to ſtop the trees that are cut down, and thrown into it above this place. The entrance into the quickſilver mines is not high, nor upon a hill, as in other mines, but in the town itſelf; the deepeſt part of the mine from the entrance, is between 120 and 130 fathoms: They make two ſorts of quickſilver; the one called *Jung frau* or *Virgin Quickſilver*, which diſcovers itſelf without the help of fire, and is either plainly to be ſeen in the ore, or falls down in little drops in the mine, and ſometimes ſtreams out plentifully; that alſo is accounted *Virgin* quickſilver, which without paſſing the fire, is ſeparated by water, firſt in a ſieve, and afterwards in a long trough, with very ſmall holes at one end: The other ſort, called *Plain Quickſilver*, is extracted by fire, either out of the ore, or out of the cinnabar of mercury dug out of this mine; the ore is

of

of a dark colour, mixed with red; but the beſt is a hard ſtone; this they powder groſsly, and work it by the ſieve, that ſo, if any *Virgin Quickſilver* be found in it, it may be ſeparated in this manner, and what does not paſs, may be extracted by fire in iron furnaces, 50 of them in a fire: The ore of this mine is very rich, ordinarily containing half and ſometimes ⅔ of quickſilver; Dr. *Brown* went into the mine by the pit of S. *Agatha*, and came up again by that of S. *Barbara*, deſcending and aſcending by ladders, one of which was 89 fathoms, it has been wrought 200 years, about the ſame ſpace of time with *Newſol* mine in upper *Hungary*, which falls much ſhort in time of the ſilver mine at *Schemnitz*, and ſhorter ſtill of the lead mines in upper *Carinthia*; ſome hundreds of men are employed in this mine of *Idria*, whoſe chief officers are the prefect, the comptroler, and the judge: In a laboratory, where the quickſilver is ſeparated by fire, he obſerved an heap of 16000 retorts of iron, each of which coſts at leaſt a crown; there are 800 retorts and as many receivers employed at once, in drawing over the quickſilver in 16 furnaces; 50 to each furnace; 25, of a ſide, 12, above and 13 below of each ſide; *June* 1669, when Dr. *Brown* was there; they carried out 40 *Saumes* of quickſilver to foreign parts, each *Saume* containing 315 pound weight, to the value of 400 ducats of gold; tho' the conveyance be not eaſy, yet ſome is ſent as far as the gold-mines at *Chremnitz* in *Hungary*, and much of it is carried ſouthward; for, tho' the river by the town be ſmall, yet they are not far from the *Sontius* or *Liſonzo*, a conſiderable river, running into the gulf of *Trieſte* in the *Adriatic* ſea; he ſaw in the caſtle 3000 *Saumes* of Quickſilver in barrels, after firſt making it up in double leather; and in another houſe he obſerved as much ore, as will take two years to diſtil, unleſs they have great plenty of rain to bring down their wood: The country is well ſtored with ſtately firs, larches, pines, wild-pines, Picea's and that nobly criſped and well grained kind of maple, of which viols and violins are made, and which abounds alſo in *Saltzburg* and *Carniola*: Travelling ſometimes in the night, great numbers of glow-worms are obſerved, which put into paper give a dim light like candles in lanthorns, the air is alſo full of ſhining flies: The way to this place is very difficult, great mountains are to be paſſed over, and coming from it, the *Swartzenberg* or black mountain muſt be croſſed, from whence we deſcend 10 miles, in a rocky

country,

country, and far more ſtony than the *Crau*, or *Campus lapidoſus* in *Provence*.

The Zirchnitzer Sea *in* Carniola; *by the Same.* Phil. Tranſ. N° 54. p. 1083.

THIS lake receives its name from the town *Zirchnitz*, it is near two *German* miles long, and one broad; on its ſouth-ſide is a great foreſt, abounding in deer, wild boars, wolves, and bears; and on the north-ſide, the country is flat, but the whole vale is encompaſſed with hills at ſome diſtance from it; this lake is well ſtored with water, for the greateſt part of the year; but in *June*, it ſinks under ground, not only ſoaking thro' the pores of the earth, but running into large apertures at bottom; in *September* it returns again by theſe holes, and in a little time fills up the vale; when the lake begins once to abate, its deſcent is very quick, and its return is as ſpeedy; for it mounts with ſuch violence at the holes, to the height of a pike, that it ſoon covers the tract of earth again; this piece of ground, in the abſence of the water, yields plenty of graſs, affording not only preſent ſuſtenance, but ſtore of hay for the cattle in winter; and at this time, it alſo yields the diverſion of hunting, for hares, deer, boars, and other animals flock thither out of the neighbouring foreſt and country; the lake is alſo well ſtored with fiſh, and the fiſhermen ſtanding in water to their waſtes at the holes, intercept their paſſage, and take great numbers of them.

Obſervations on the Thermometer; *by Dr.* Beale. Phil. Tranſ. N° 55. p. 1114.

DEcember 26th, 1669, in the morning, the weather was colder than ever Dr. *Beal* obſerved it, the liquor ſtanding 3 ½ inches; *Dec.* 29th, and one or two other mornings, it ſtood at 3 ¾ inches; at moſt other times of theſe cold days, morning and evening, it was at the height of four inches; in ordinary briſk froſts at 7 inches; and it is to be obſerved, that ſometimes, at that height, the froſt diſſolves, and again it is at 8 inches in a ſmart froſt; at 10 it is warm *May* weather, and not much above 12, in the hotteſt day of *June*, *July*, and *Auguſt*; it is ſomething remarkable, that the 7th inch and ſometimes the 8th ſhould be freezing, and the froſt increaſe, till the liquor deſcend 4 ½ inches; and yet that it ſhould not aſcend from the 8th inch more than 4 ½ inches in our hotteſt ſummer: But now, he ſays, he is ſtrongly per-

persuaded, that the degrees of heat and cold are not exactly indicated by the inclosed spirit of wine; for when the snow melted, and the frost was first dissolved without sun-shine, the liquor was not above $5\frac{1}{2}$ inches.

Observations on the Barometer *and* Thermometer; *by Dr.* Wallis, Phil. Transf. N° 55. p. 1116.

WHereas Dr. *Wallis* formerly observed, that the barometer rose sensibly in hot weather; he now found, after keeping the same barometer for five years, the case to be otherwise, and that in hot sun-shiny weather, the mercury subsided a little, and in extreme cold and frosty weather it rose; owing possibly to some quantity of air remaining in the mercury, which is expanded by heat, and again contracted by the cold; but that air being now disentangled from the mercury, and got up into the empty part of the tube above the quicksilver, acts in a contrary manner upon it; for when expanded by heat, it presses the mercury downwards; and when again contracted by the cold, the quicksilver, freed from its pressure, rises a little; tho' the rising and sinking of the mercury, on this account, be not very considerable, hardly exceeding $\frac{1}{12}$ of an inch; and again, a drop of the water, as Dr. *Wallis* observed, used in freeing the mercury from the air, remaining on the top of the quicksilver in the tube, may upon its freezing hinder the ascent of the mercury: *Jan.* 7, $16\frac{66}{67}$, the barometer was at 29; but for some days before, about $28\frac{3}{4}$, the weather having been windy and rainy, and so it was in the frost, about *Dec.* 25; but then it continued to rise till about *Jan.* 2, to $29\frac{3}{8}$; and was *Dec.* 13, at $30\frac{1}{8}$, the highest he ever observed it; and *October* 26, 1665, at $27\frac{7}{8}$, the lowest; the usual height being about 29, or somewhat higher.

The thermometer was about 28 inches, and its bore $\frac{1}{8}$ of an inch in diameter, with a small spherical bowl at top, of about $\frac{3}{4}$ of an inch in diameter, and another at bottom, about 2 inches in diameter, which contained spirit of wine, tinged with cochineel; the lowest point to which the liquor subsided, in very hard frosts and cold winds, was $12\frac{1}{4}$ inches; the height, the following summer, 1665, was usually at 20, 21, 22, or thereabouts; and in some very hot days, at 25, 26, and $26\frac{1}{2}$; the winter following, *Dec. Jan.* and *Feb.* there was at $14\frac{1}{2}$ frost certain; sometimes at 15, or higher; and the lowest, that winter, was $12\frac{3}{4}$; the summer following, 1666, it was usually about 19, 20, 21, and the highest of all, at 25: About the end of *Dec.* 1666, and the beginning of the *Jan.* following, it was in hard frosty weather, at

12, 11, and once at $10\frac{1}{2}$; and it was froſt certain, that winter, about $13\frac{1}{2}$, an inch lower than the preceeding years, and ſometimes at 14, or $14\frac{1}{2}$; the uſual height, the ſummer following, was about 19, 20, 21, and the higheſt $24\frac{1}{2}$; the winter 1667, it was ſcarce certain froſt at 13, yet ſometimes at 14, or a little higher; the loweſt deſcent that winter, was 12; and the following ſummer, the height was uſually about 18, 19, 20; and the higheſt of all, that ſummer being very moderate, at 22: *Chriſtmas* 1669, tho' it was froſt certain about $12\frac{1}{4}$, and ſometimes higher than 13; yet *Dec.* 26, in the morning, it deſcended to $7\frac{3}{4}$, which was the loweſt he ever obſerved it.

An Account of a Salt-ſpring *in* Somerſetſhire, *and a medical* Spring *in* Dorſetſhire; *by Dr.* Highmore. Phil. Tranſ. N° 56. p. 1130.

DEcember 1669, by an experiment on the ſalt-ſpring at *Eaſt-Chenock* in *Somerſetſhire*, about 20 miles from the ſea, and then not ſo ſalt as in ſummer, becauſe of the rains, from a wine quart, there were near 80 grains obtained by evaporation.

The waters at *Farrington* in *Dorſetſhire* ſeem to be chiefly impregnated with vitriol, or ſalt of iron, which is very volatile, ſo that little of it can be had by evaporation, or from the precipitated ſediment; the proportion of ſalt in this water he found thus, he put four ounces of ordinary water into a glaſs, and impregnated it with galls; then he gradually drop'd into it about two grains of ſalt of iron, till he found it as deeply tinged red, as the ſame quantity of *Farrington* waters would be with the ſame proportion of galls; this water, ſo tinged, had the taſte and flavour of the natural water from the ſpring impregnated with galls; if a greater proportion of ſalt had been added, it would make it nauſeous and emetical.

Diſtillations *by Cold*; *by Dr.* Beale. Phil. Tranſ. N° 56. p. 1140.

UPON expoſing abroad, in the hardeſt froſts of 1665, a thermometer of a ſlender ſtem, with deeply tinged ſpirit of wine; there aſcended to the top of the glaſs ſmall drops, like a dew, which afterwards deſcended into the ſtem, filling up the ſpace of an inch, as clear and bright, as any cryſtal or glaſs; but upon placing a ſtronger thermometer of ſlow motion on a ſunny wall, till a part of the liquor aſcended, where it continued ſome hours; then by ſloping the glaſs, it was ſeparated from the reſt, and took up two inches in the ſtem; it was at firſt of a very pale red, which might

might be owing to ſpirit of urine, mixed with the ſpirit of wine; but in a little time, all the red vaniſhed, and it became of a languid tranſparency, by no means ſo bright and ſparkling as the other.

Obſervations in New England; *by Mr.* Winthrop. Phil. Tranſ. N° 57. p. 1151.

IN the in-land country of *New England*, there are whole foreſts of a ſort of dwarf oak, which, tho' low and ſlender, bears acorns; the land, by the ſpreading of its ſtrong roots, is very difficult to break up with the plough.

Upon the bark of a certain tree growing in *Nova Scotia*, and in the more eaſterly parts of *New England*, there are little knobs, containing a liquid matter like turpentine, of a very healing nature.

The pods of the vegetable, called *Silk-graſs*, are full of a kind of fine cotton; many of theſe flocks, in one and the ſame pod, end in a flat ſeed; it is uſed in ſtuffing pillows and cuſhions; and neither it, or the down of cotton-trees which grow tall and big, are fit to ſpin; at the bottom of ſome of the leaves, near the ſtalk, is a hollow knob, breeding a fly like a piſmire.

The ſhells, of which the *Indians* make the *white Wampanpeage*, a ſort of money among them, grow in matrix's at the bottom of ſea-bays; they are like periwinkles, but larger.

Fig. 1. Plate VIII. repreſents a ſtrange kind of fiſh, which we may call *Piſcis echino-ſtellaris viſciformis*, its body reſembles an *Echinus* or egg-fiſh; the main branches, a ſtar; and the diviſion of the branches, the plant miſletoe; this fiſh ſpreads itſelf from a pentagonal root, encompaſſing the mouth *a* into five branches, each of which is ſubdivided into two, as at 1; and each of theſe ten branches are again divided into two at 2, making twenty leſſer branches; each of which, at 3, divide into two ſmaller branches, in all, 40; theſe again, at 4, into 80; and thoſe, at 5, into 160; and theſe, at 6, into 320; at 7, into 640; at 8, into 1280; at 9, into 2560; at 10, into 5120; at 11, into 10240; at 12, into 20480; at 13, into 40960; at 14, into 81920; beyond which, the farther expanſion of the fiſh could not be certainly traced; tho' poſſibly, each of thoſe 81920 ſmall threads, might, if examined, whilſt the fiſh was living, have been found to be further ſubdivided: The body of the fiſh was on the other ſide, and ſeemed to have been prominent, much like an *Echinus*.

Mr. *Willoughby* obſerves, that this fiſh is the *Stella arboreſcens* of *Rondeletius* p. 121, firſt deſcribed by him, and ſince by other naturaliſts.

Obſervations on the Motion of Sap *in* Trees; *by Mr.* Willoughby. Phil. Tranſ. N° 57. p. 1166.

IN *January*, making inciſions in the ſycamore and common maple, they were obſerved to bleed faſter, as the weather grew hotter; and the ſucceeding cold was ſo far from promoting, that it hindered their bleeding; ſo that the aſcent of the ſap of trees depends on a certain degree of heat, ſufficient to raiſe, but not to coagulate their reſpective juices; in months, wherein the heat ordinarily falls ſhort of that degree; an accidental warmth of weather promotes the bleeding; but in months, wherein the ordinary temperature of the air exceeds that degree, colder weather makes them bleed a-freſh: In walnut-trees it was never found, that heat promotes their bleeding, but cold always does: In *March*, roots of birch, as alſo, thoſe of ſycamores, bled at both extremities: Upon the firſt froſt in *November*, Dr. *Liſter* obſerved a ſycamore to bleed copiouſly; ſo that the ſap cannot be ſaid to riſe in *January*, but immediately after the fall of the leaf, in this tree.

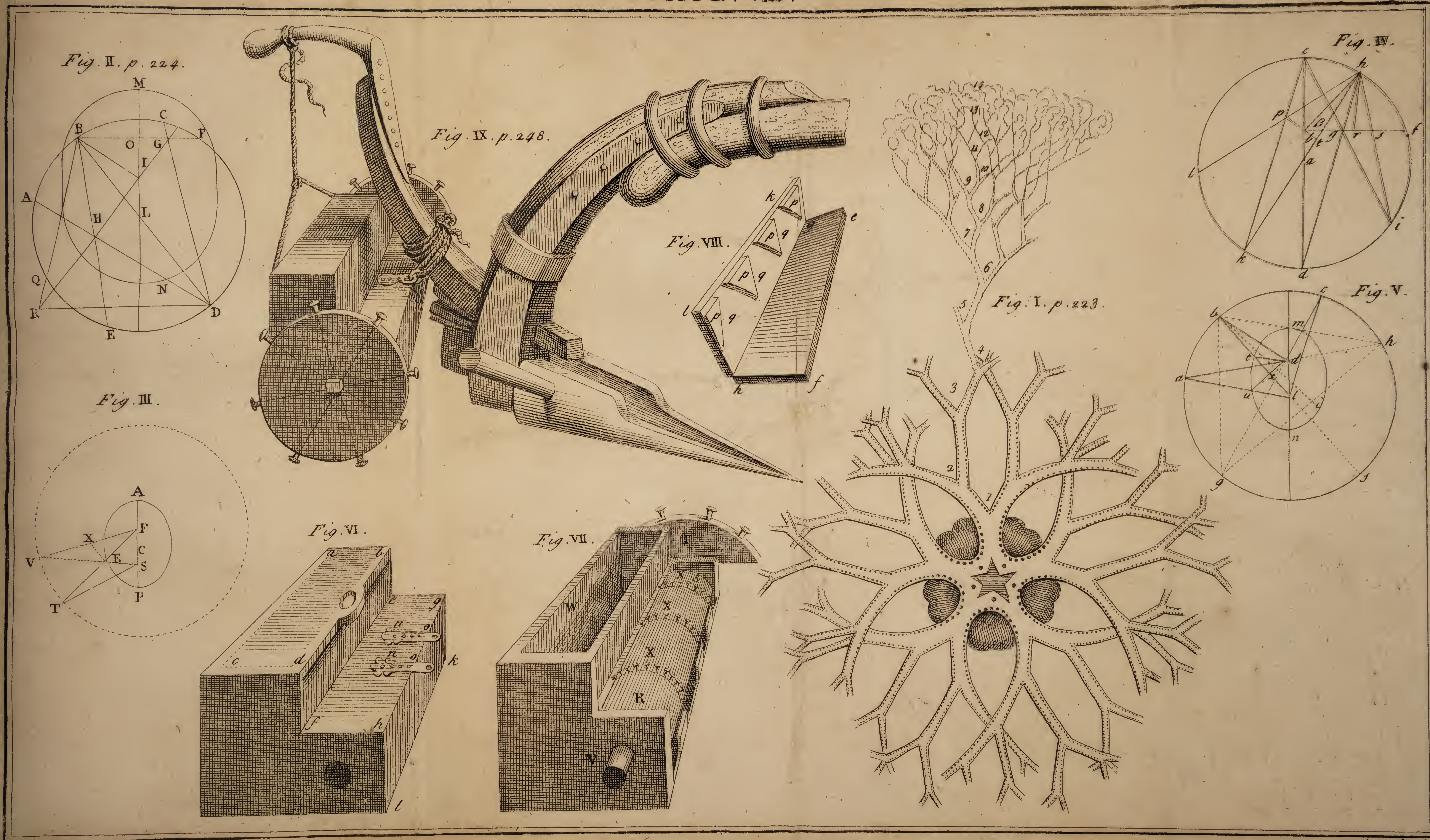
Some Conſiderations on M. Caſſini's *Method of finding the* Apogæa, Excentricities, *and* Anomalies *of the* Planets; *by M.* Nic. Mercator. Phil. Tranſ. N° 57. p. 1168. Tranſlated from the *Latin.*

M. *Caſſini* ſuppoſes, two lines drawn from both foci to the planet revolving in an ellipſis, one of which is the line of the mean motion, and the other that of the true.

I. Fig. 2. Pl. VIII. L is the centre of the cocentric A B C D E; B L D the diameter; B A, B C, B P, the apparent diſtances; D E, D F, D Q, the diſtances of the mean motion; B E, B F, B Q, as alſo, D A, D C, D P are right lines; B E interſects D A, in H; B F, D C, in G; and B Q, D P, in R; R H G is a right line; B I a perpendicular to R H G; I the centre of the ellipſis; L I = I O the excentricity; O the focus, and the centre of the mean motion; L, the other focus and centre of the true motion I M = I N = L B; M, the apogæum; N, the perigæum; B L M, the true anomaly.

Biſhop *Ward*, in his *Examen Aſtronomiæ Philolaicæ*, publiſhed at *Oxford* 1653, has *cap. 6.* laid down a method of finding the true anomaly of the planets from their mean anomaly, and which

PLATE. VIII.



Hulett Sculp

which is this: Fig. 3. C is the centre of the ellipsis A E P; F the focus and centre of the mean motion; S the focus and centre of the true motion; A the apogæum; P the perigæum; E the planet; A F E the mean anomaly; A S E the true anomaly; F E T a right line; E T = S E; S T a right line: In the triangle S F T are given S F the distance of the foci; F T = F E + E S = A P; and A F T, the external angle, or mean anomaly equal the sum of the angles F S T and T: Therefore the angle F S E, or the true anomaly = the difference of the angles F S T and T, may be found, *viz.* as half the sum of the sides F T and F S to half their difference, so the tangent of half the sum of the angles F S T and T, to the tangent of half their difference; but half the sum of the sides F T and F S is found, by substituting for F T its equal A P, whose half is A C, which added to C S the half of F S, makes the half sum A S, the greatest distance of the planet; if then you substract from A S the lesser side F S, there remains the half difference of the sides F A = P S, the least distance of the planet; and the rule for finding the true anomaly from the mean will be; as A S the greatest distance of the planet, to P S its least distance; so is the tangent of half the mean anomaly, to the tangent of half the true anomaly.

COR. 1. If S E be produced to U, so as E U be = F E, and the whole S U = A P the axis; the angle U of the triangle F S U will be half of the prosthaphæresis F E S, consequently = to the half difference of the angles of the true and mean anomalies, that is, of the angles A F E and A S E; and the external angle A F U = their half sum, after substracting the half difference U F E from the greater A F E; whence there arise two analogies:

1. As the sine of half the sum of the mean and true anomalies, A F U, to the sine of half their difference U; so is S U = A P the transverse axis, to S F, the distance of the foci.

2. As the sine of half the sum of the mean and true anomalies A F U, to the sine of the true anomaly, F S U; so is S U, or the axis A P, to F U, the subtense of the true anomaly; so likewise, the semi-axis, A C, to the semi-subtense U X or F X.

COR. 2. If, in the same triangle, F S U, be erected on half the subtense F U, the perpendicular X E, it will intersect S U into two parts, of which the one U E is = F E, the line of the mean motion, and the other S E, is the line of the true motion.

II. Fig. 4. Let *a* be the centre of the cocentric *c h f i*; *c a d*, both the diameter and line of the apses; *c h*, the arch of the true anomaly, to which, *d i*, the arch of the mean anomaly answers; therefore, *c d h*, is the angle of half the true anomaly, and *d c i*, the

the angle of half the mean anomaly; ci and dh are right lines interſecting each other in g; from the point of interſection g, let fall the perpendicular gb to cd; and it will be, $db : bg$: : Radius to the tangent of bdg, or cdh; and, cb : bg : : Rad. to tang. of bcg, or, dci; conſequently, $db \times$ tang. of $cdh = bg \times$ Rad. $= cb \times$ tang. of dci; wherefore, db : cb : : tang. of dci : tang. of cdh; that is, db : cb : : tang. of half the mean anomaly : tang. of half the true anomaly; conſequently, by the preceeding rule, as the greateſt diſtance of the planet, to its leaſt; wherefore, db, will be equal the greateſt diſtance, and cb, the leaſt, and ab, the accentricity; and ſince the ſame demonſtration holds of all the other points of interſection, *viz.* that the perpendiculars from them to the line cd fall upon the point b; the line joining theſe interſections muſt coincide with the perpendicular bgf.

III. Having drawn the diameter hak, let the arch kl be equal to the arch id, and draw kc and hl interſecting each other in p; let fall the perpendicular hr from h upon bgf, and parallel to the line of the apſes cd; the angle rhs will be equal the half difference of ch the true analomy and di the mean; then draw the right line $h\beta$ from the ſame point h, making with kh an angle equal to rhs, and meeting the line of the apſes in β, the angle βah will be the meaſure of the arch ch, or, the true anomaly, and βha, the half difference of the true and mean anomalies, by the conſtruction; and the external angle $c\beta h$, which is equal to the two internal and oppoſite angles βah and βha, and conſequently compounded of the true anomaly, and half its difference from the mean, will be half the ſum of the true and mean anomalies; conſequently by the former analogy of the firſt corollary, as the ſine of $c\beta h$, to the ſine of βha, ſo is the radius ah, to the excentricity $a\beta$; but it was demonſtrated above, that ab is alſo equal to the eccentricity; therefore the point β coincides with the point b; erect bt perpendicular to hb, I ſay, if produced, it will fall on the point of interſection p; for the triangles rhs and bht are ſimilar by the conſtruction; as alſo the triangle hpk is ſimilar to hgi, for the angles pkh and gih are equal, inſiſting upon the ſame arch, ch, as alſo, the angles, phk and ghi inſiſting on the equal peripheries kl and id, conſequently the two other angles hpk and hgi are equal; and taking away the equal angles bht and rhs from the equal ones, phk and ghi, phb will remain equal to ghr; whence I argue thus, $frh = tbh$, and $rhs = bht$, therefore $hsr = htb$,

con-

consequently their complements to a semi-circle are equal, *viz.* $rsi = btk$, and $sig = tkp$, and consequently $igs = kpt$, which substracted from the equal angles igh and kph, there remains $hgs = hpt$, and $ghr = phb$, therefore $hrg = hbp$, but hrg is a right angle, consequently, hbp is also one; and since hbt is a right angle by construction, tb will make the same right line with bp; and seeing the same demonstration holds of any other intersection of lines drawn from h and k to the corresponding points of the true and mean anomalies; it is plain, that not only the right line that joins these intersections will pass thro' the point b, but that hb will be a perpendicular to it, Q. E. D.

Cor. If from any point of the true anomaly as h, to a corresponding point of the mean anomaly i, you draw the right line hi; bf raised perpendicular to cbd will intersect hi in s, in the ratio, the line of the mean motion has to that of the true; for by the latter analogy of the first corollary, hb is the half subtense, consequently by Cor. 2. the perpendicular erected from b, *viz.* bt intersects the diameter hk, in t, in the ratio, the line of the mean motion has to that of the true; therefore, rs, or bf intersects hi in the same ratio in s, because of the similar figures $tbhkphb$, and $frhighr$.

Another method of finding the apogæa and eccentricities from that of Dr. *Ward* for finding the first inequality: Let l and d be the two foci of the ellipsis; t and u two points of the planets true motion; tu, an arch of the ellipsis, seen from l, under the angle tlu, and from d, under the angle tdu; also ld, the distance of the foci, seen from t, under the angle dtl, and from u, under the angle dul; I say, the difference of the angles, tlu and tdu, is equal to the difference of the angles dtl and dul: For since the sum of the three angles of the triangle lux is equal to that of the triangle dtx; and if from both sums, the equal angles lxu and dxt be deducted, the remainder will be $ulx + lux = tdx + dtx$; and if from these two sums you substract the unequal angles ulx, and tdx, the difference of the remaining angles lux and dtx is equal the difference of the substracted angles ulx and tdx.

From the centre l, and distance mn of the transverse axis, describe the circle abc, whose arch ab is seen from l under the angle alb, and from d, under the angle adb; also the distance of the foci ld, seen from a, under the angle lad, and from b, under the angle lbd; therefore, the difference of the angles alb and adb is equal the difference of the angles lad

and

and lbd; but by Cor. 1. the angle lad is half the angle lud, and the angle lbd, half the angle, ltd; therefore the difference of the angles lad and lbd is equal half the difference of the angles lud and ltd; and consequently, the difference of the angles alb and adb is equal half the difference of the angles ult and udt, the former of which, is the apparent interval of two observations, and the latter, the interval of the mean motion; the difference of those intervals being given, we have the half of this difference, *viz.* the difference of the angles alb and adb; but alb is the same with ult, which is given; we have therefore the angle abd, under which, the arch ab is seen from d.

After the same manner, it will be demonstrated, that the difference of the angles, tly and tdy, is equal to the sum of the angles ltd and lyd; as also that the difference of the angles blc, and bdc is equal to the sum of the angles lbd and lcd; and seeing lbd is the half of ltd, and lcd, half of lyd; the sum of lbd and lcd will be equal to half the sum of the angles ltd and lyd, that is, the difference of the angles blc and bdc will be equal to half the difference of the angles tly and tdy, the former of which is the apparent interval of two observations, and the latter, that of the mean motion; wherefore their difference being given, we have the difference of the angles blc and bdc; but blc is the same with the given tly; therefore, the angle bdc is also given, under which the arch bc is seen from d: whence it appears, that from the given mean and apparent intervals of two observations, the angles are given, under which, any arches of the circle abc are seen, intercepted between the lines of the true motion; wherefore, by *Herigon's Theor. plan. l.* 1. *c* 3. *prop.* 12 *Schol.* 1. so many segments of a circle may be described, which may contain the angles, under which these arches are seen from d, all which segments will intersect each other mutually in d; and after this manner, the apogæa and eccentricities of the planets may be found by a geometrical delineation, and with any number of observations: and circles be as easily drawn as right lines: But to grant what is true, *viz.* that the geometrical delineation of M. *Cassini* is somewhat more expeditious; yet should we aim at that accuracy astronomers desire, it might be feared, it would require very large diagrams, and become more operose than the calculus itself: It now remains that we examine the hypothesis.

The invention of the elliptical orbit is undoubtedly owing to *Kepler*; but the determining the degrees of the acceleration and

and retardation with which the planets move, is no leſs neceſſary for compleating the hypotheſis, than the defining the orbit itſelf; tho' nothing to this purpoſe is to be obſerved in *Caſſini* or his interpreter; and from the conſtruction of the problem, and its ſolution, it is manifeſt that he ſuppoſes a planet ſeems to move from the ſuperior focus with an equable motion; and *Kepler* himſelf was of this opinion, as appears from his writings; but when he found that this did not agree with his obſervations he changed his mind, and maintained that the line of the true motion of a planet deſcribed equal areas in equal times, and that there is no point, from which a planet is ſeen to move with an exactly equable motion, unleſs we ſuppoſe it a librating point, and that the equable motion of a planet cannot be more properly aſſigned to any point than the ſuperior focus; no body has yet denied that *Kepler's* area's do not ſalve the appearances; but ſince, neither he himſelf nor any after him, could determine them by a direct calculus, ſome have blamed *Kepler* as giving way too much to phyſical cauſes and ſwerving from geometry; as if phyſical cauſes were inconſiſtent with it; or, as if the problem were too ungeometrical, which, without mentioning phyſical cauſes, is thus propoſed, the area of the trilinear figure intercepted between the line of the apſes and that of the true motion, and the elliptical periphery, being given to find the angle at the ſun.

M. *Bullialdus* attempted to inveſtigate by geometrical reaſonings both the orbit, and the degrees of remiſſion and intenſion in the motion of the planets; that we might be led from that equable motion, aſſumed by aſtronomers before *Kepler's* time, to that inequality obſerved in the heavens; and biſhop *Ward*, adopting this hypotheſis, firſt ſhows how to do the like with the line of the equable motion revolved round the other focus of the ellipſis, and then gives that method of direct calculation, which we have repeated above; and two years after the illuſtrious count *Pagan* undertook to maintain the truth of this hypotheſis, ſo far, that he aſcribed a difference of about $\frac{1}{7}$ that was found out, to the unſkilfullneſs of aſtronomers; but M. *Bullialdus*, upon ſecond thoughts, and conſidering that aſtronomical obſervations were the beſt guides, upon applying ſome limitation to his former inventions, made that difference vaniſh: Whence then it appears, that that hypotheſis, whereon M. *Caſſini* builds the inveſtigation of the apogæa and eccentricities, ſwerves ſo far from the truth, as is that limitation of *Bullialdus*.

Longevity, *and the Causes of natural* Death; *with some Observations made in the* South *of* France; *by M.* de Martel. Phil. Transf. N° 58. p. 1179.

THE extinction of natural heat, and the drying up of the radical moisture, are commonly assigned as the causes of old age and natural death; and it is supposed, that this hot and moist principle of life, in its own nature dissipable, not being perfectly repaired by food, is considerably diminished, which brings on old age, and being at last quite consumed, causes natural death; and here a great difference is made between the seminal heat and moisture, and that which proceeds from aliment; so that the former cannot be repaired by the latter, as being heterogeneous to it; which seems to be false, for this seminal heat and moisture originally proceed from what is superfluous of the third concoction of the aliments; it is therefore of the same nature, and nothing hinders, but what is dissipated may be perfectly restored by good nourishment, well prepared, and taken seasonably, and in due quantity: The illustrious *Bacon*, finding the weakness of this supposition, was of opinion, that this defect proceeded from the uneqnal reparation of the liquid and solid parts, which jointly serve to repair and maintain themselves; whence it happens, that the parts the most easy to repair, and the most necessary for life, as the *blood*, cease at last to be sufficiently repaired by the defect of the others, which are not repaired at all: *Sanctorius*, almost of the same fentiment, holds that natural death happens, from the fibres drying up in such a manner, that they can no more be renewed; life according to him, depending upon the renovation of the parts; but this account is so far from being satisfactory, that it is observed, that even bones themselves, which are the hardest parts, are capable of renovation in old age; in regard, that old oxen have at certain times their bones dry and without marrow; and at other times are bedewed with a substance of the nature of marrow, which enlarges their pores, and softens them, especially upon feeding in good pasture in the spring.

M. *De Martel* supposes, that the blood is the principle of life, as far as it is vital, that is, as far as it is put in motion by the hot particles contained therein; so that those who expire by age, do not die for want of blood, which is found plentiful and laudable enough in their vessels; and which has been sufficiently repaired till then; but because it ceases to be vital, by reason of the too easy dissipation of the igneous particles, which, according to

to him, happens, as in wine, that evaporates and loſes its ſtrength by the fault of the veſſel, which by ſome opening or other emits what gives virtue to the wine: The coats and membranes of the veins and arteries, which contain the blood, wear away in time, and wax thin, and their texture gives and breaks in ſeveral places, at which apertures the igneous particles of the blood fly off: So that, if we had the art of reinforcing and ſtrengthening anew thoſe coats and membranes, that they might not let ſlip what renders the blood vital, life would be preſerved perpetually; and this appears from the life of many dying perſons being protracted for ſome time, by making them ſwallow down ſome hot and ſpirituous liquor, as ſpirit of wine, or ſome eſſence, by which the blood is ſtrengthened and quickened for a few moments; but as this reinforcement of life, conveyed to the heart, and running into the veins, ſoon ſlips out, ſo alſo, this new vigour quickly paſſes away: But as there is no reaſon to deſpair of finding out ſuch medicines, or aliments, as are proper to ſtrengthen the coats and membranes of the veſſels, ſo as at all times to be capable of retaining the fiery and ſpirituous particles of the blood, as well as in youth; ſo we may alſo hope to be enabled to maintain the blood in a condition of always ſupplying alike, as in our vigorous age, for all the functions of life.

The manner of making the *Muſcadine* wine at *Frontignac*, is this, they let the grapes grow half dry upon the vine, and as ſoon as they are gathered, they tread and preſs them immediately, and tun up the liquor, without letting it ſtand, and work in the fat, the lee cauſing its goodneſs: Upon paſſing white wine of another kind on the huſks of the *Muſcadine* grapes, there was made an excellent wine, of the taſte of *Muſcadine*, and more pleaſing to ſome, and not ſo heady, as the true *Muſcadine*.

On the road of *Beziers* to *Narbonne*, in a pretty large place, at the diſtance of two miles from the ſea, and raiſed above its level about 15 or 16 fathoms, M. *De Martel* obſerved rocks, which incloſed a great number of big petrified oiſters; and on the ſame road, above the place, called *Nice*, at the higheſt part of the craggy deſcent, where the rock is cut to make a paſſage, is ſeen a bed, two foot wide, of many petrified cockle-ſhells, heaped up, as ordinarily they are on the ſea ſhore, which ſufficiently proves that the ſea formerly covered this place.

In a body that was opened, the liquor contained in the *Pericardium*, was found congealed into a conſiſtence fit to be cut with a knife, and thick two fingers ſquare about the heart.

Magnetical Variations *at* Rome; *by M.* Auzout. Phil. Transf. N° 58. p. 1184.

M. *Auzout* making the following obfervation at *Rome* on feveral meridian lines with a needle, about fix inches long; found it to decline on all of them, fomewhat more than two degrees weftward, and on fome, near 2 ½ degrees; but by former obfervations, it appears, that the needle declined eight degrees eaftward, afterwards diminifhing, till it came to where it is at prefent, *viz.* 1670: This difference of more than 10° cannot be attributed to the change of the earth's pole, as fome would have it; nor, according to others, to the magnet or iron, that are found in certain places; for M. *Auzout* affirms, that the mines he has feen, make no impreffion at all on the needle; fo that it is difficult to hit the true caufe of fuch a variation; yet however, if the direction of the magnet, and of the needle touched by it, depends upon the flux of a certain matter, paffing thro' the earth, or its exterior parts, ftrait along the axis, it may be faid, that it proceeds from changes made in the faid flux, which, fuppofing the inequalities of the earth, and the alterations continually made therein, by art or nature, as by excavations and other like works, or by the effects of fire and water, or by the generation of metals and ftones, cannot but in procefs of time change its fituation; as rivers wind and change their courfe, according to the ground over which they run; fo the inequalities of the earth may alter the current of the magnetic matter, and the needle change its direction according to that of the current, on which it depends: And if this be the cafe, there are no hopes of finding a regular hypothefis to account for fuch a change, that depends upon fuch irregular caufes.

Anatomical *Obfervations*; *by S.* Jacomo Grandi. Phil. Tranf. N° 58. p. 1188.

S. *Grandi* obferved the *Virfungian* or pancreatic duct, manifeftly inferting itfelf into the fpleen, and admitting a filver ftiletto; he alfo obferved a liver divided into five lobes, together with a fpleen, of the figure of a faw, and of an extraordinary bignefs: In one that was drowned, the lacteals were fo plain and fo big, that having fhewn how they lay in the body, next day after, he fhewed them in the mefentery, after taking it out, and difplaying it on a table: He alfo obferved two odd births; one was of twin females, which were fo faftened together by the breaft in fuch a manner, that there appeared but one trunk, and they

they were alſo joined by the chin: They had but one heart, greater and rounder than ordinary, with two lungs, and one ſtomach; whoſe *Pylorus* branched itſelf into two diviſions in the bowels; there was only one big liver, but two ſpleens, four kidneys, two wombs full of a white matter, like concreted *Semen*; two *Vulva's*, with their diſtinct *Hymens*: The other monſter was a boy, born with his breaſt open, the bowels out of the belly, the legs diſtorted, the bladder in the place of the fundament, the *Teſticuli* cloſe to the kidneys, and the genitals nothing but a membranous expanſion, wherein the ſpermatic arteries were loſt.

The Salt-Mines *in* Tranſylvania *and* Hungary, *and the* Gold *and* Silver-Mines *of the latter*; *by Dr.* Edw. Brown. Phil. Tranſ. N° 58. p. 1191.

THERE are two kinds of *Tranſylvanian Stone Salt*; the *Sal-gemmæ*, and that commonly uſed at table; the latter is found in moſt of the ſalt-mines; and is brought in great quantities down the river *Tibiſcus*, and the rivers running into it; ſome of which is afterwards ſent down the *Danube*, and up the *Morava*, to furniſh *Servia*, and the adjacent provinces; and a great part of it up the *Danube*, into *Hungary*; but they bring it no higher, ſtone-ſalt being prohibited in *Auſtria* by the emperor, who has conſiderable profit upon the boiled ſalt brought from *Hallſtadt*, in that province.

Near *Eperies*, in *Upper Hungary*, is a ſalt mine of great note, about 180 fathoms deep, the deſcent, for ſome way, is by ropes, and then by ladders, it is for the moſt part in an earthy, not rocky ground: The veins of ſalt are large, and there are ſome pieces weighing ten thouſand pound: They commonly hew out the ſalt into long ſquare pieces of two foot in length, and one in thickneſs; and for uſe, it is broken and ground between two grind-ſtones: The mine is cold and damp; but the ſalt, being a ſtone-ſalt, is not eaſily diſſolved, or at leaſt, in any great quantity, by dampneſs or moiſture; yet the water of the mine is impregnated with ſalt, to ſuch a degree, that being drawn out in large buckets, and afterwards boiled up, it affords a blackiſh ſalt, which they give to their cattle: The colour of the ordinary ſtone-ſalt of this mine is not very white, but ſomewhat grey; yet, being broken and ground to powder, it becomes as white, as if it was refined; and this ſalt conſiſts of pointed parts or *Foſſets*; there is another ſort, conſiſting of ſquares and tables; and a third, like icicles, or with long ſhoots: All the ſalt of this mine is of different colours; that which is found mix'd with the earth, partakes of

of its colour; and even the pureſt, and what reſembles cryſtal, often receives tinctures of ſeveral other colours; in the middle of a cryſtal ſalt with long ſhoots, Dr. *Brown* has ſeen a delicate blue; there are alſo ſome pieces very clear and tranſparent, and ſo hard, that they carve them into divers figures, as croſſes, crucifixes and others: Theſe ſalts, tho' kept without care, remained dry for many months in other countries, yet, after being brought over into *England*, they began to give way; and if they are kept in a ſtove, or very hot place, they will be apt to loſe their tranſparency.

Of the ſeven mine-towns in *Hungary*, which are *Chremnitz*, *Schemnitz*, *Newſol*, *Koningsberg*, *Bochantz*, *Libeten* and *Tiln*; *Chremnitz* is the richeſt in gold; there are alſo good-mines at *Bochantz* and *Koningsberg*; and they report in that country, that there has been formerly, a rich gold-mine at *Glas-hitten*, but it is now loſt, *Bethlem Gabor* over-running theſe parts, the undertakers ſtopt up the mine, and fled: They have wrought in the gold-mine at *Chremnitz*, 900 years; it is ſeveral *Engliſh* miles in length, and about 160 fathoms deep; many veins of the ore run to the north and eaſt; they work alſo, towards one, two and three of the clock, as they ſpeak; for the miners direct themſelves under ground by a compaſs not ſuch as is uſed at ſea of 32 points, but by one of 24; which they divide, as we do the hours of the day, into twice 12: Some of the gold ore is white, ſome black, red or yellow; that with black ſpots in white is eſteemed the beſt, as alſo the ore, which lies next to the black veins: This ore is not rich enough to ſuffer any proof in ſmall parcels, like that of other mines, in order to know the proportion of metal it contains; but they pound a great quantity of it, and waſh it in a little river, running near the town: The whole river being divided and received into ſeveral channels, runs continually over the ore, and ſo waſhes away the earthy from the metalline parts: There have been pieces of pure gold found in this mine, ſome of which he ſaw in the emperor's treaſury, and in the elector of *Saxony*'s repoſitory, one piece as broad as the palm of the hand, and others leſs; and upon a white ſtone, many pieces of pure gold; but theſe are very rare: The common yellow earth of the country near *Chremnitz*, altho' not eſteemed ore, affords ſome gold; and in one place he ſaw a great part of a hill dug away, which had been caſt into the works, waſhed and wrought in the ſame manner, as pounded ore, with conſiderable profit: Some paſſages in this mine, cut thro' the rock, and long diſuſed have filled

filled up again; and he obſerved the ſides of ſome, which had been formerly wide enough to carry their ore thro', to approach each other, ſo that the paſſage became difficult: This happens in moiſt places; and they unite not from top to bottom, but from one ſide to the other: There is in this mine, white, red, blue and green vitriol, and alſo vitriolate waters: There is a ſubſtance, ſticking to the gold ore, with ſmall pointed parts, like needles, called by them *Antimony of Gold*; they find cryſtals here, and ſome tinged yellow: The miners will not allow of any quickſilver or brimſtone to have been found here; yet in the *Antimony of Gold*, there is ſulphur, as appears by burning it: The quickſilver-mine mentioned in the anſwer to *Kircher*'s inquiries, in his *Mund. Subterr.* is an *Hungarian* mile, or ſeven *Engliſh* miles diſtant from *Chremnitz*, and not wrought at preſent, *viz.* 1670: There is a vitriol-mine in theſe hills, nigh the gold-mine; whoſe earth or ore is reddiſh, and ſometimes greeniſh; this earth is infuſed in water, and after three days, the water is poured off, and boiled ſeven days in a leaden veſſel, till it comes to a thick granulated whitiſh ſubſtance, which is afterwards reduced to a *calx*, in an oven, and ſerves in the making of the *Aquafortis*, uſed at *Schemnitz*.

They have ſeveral ways of ſeparating the gold from the ore; as burning, melting, and adding ſilver ore and other minerals, ſand and lead, according as the ore is fluid or fixt: Without lead they proceed thus; they break and pound the ore very fine in water; they waſh it often, and lay it in powder upon cloths, and by the gentle oblique deſcent of the water over it, and their continual ſtirring it, the earthy, clayey, and lighter parts are waſhed away, while the heavier and metalline remain in the cloth; theſe cloths are afterwards waſhed clean in ſeveral tubs, and the water, after ſettling a little, is poured of from its ſediment; which ſediment is again waſhed, and ſtirred up in ſeveral veſſels and troughs, till at length they ſprinkle quickſilver upon it, and knead it well together for an hour, and then they waſh it again in a wooden veſſel; ſtriking the veſſel againſt their leg, they bring the gold and quickſilver together into an *Amalgama*; from this *Amalgama*, they ſtrain as much of the quickſilver, as they can, firſt thro' coarſe, and then thro' fine cloths; the remaining maſs is put upon a perforated plate, which is ſet over a deep pan placed in the earth, in the bottom of which pan they alſo put quickſilver; and this pan is covered, and the cover well luted, and then they make a charcoal fire upon it; and they drive down the quickſilver,

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yet remaining in the gold, to the rest in the bottom of the pan; then taking out the gold, they throw it into the fire, that it may still become purer.

There are several silver-mines at *Schemnitz*; but the principal, and those most wrought, are the mines of *Windschacht* and *Trinity*.

They have no river here, tho' much water in the mines, so that they are obliged to send much of their ore to *Hodritz* and other places, where there are small rivers, by which their bellows and hammers may be moved, their ore pounded and washed, and other necessary works performed: They have engines to pump the water out of the mines, moved by wheels, which are turned round continually by horses, 12 at a time to each wheel. In *Windschacht* mine, which lies deep in the earth, is a large wheel of 12 yards diameter, turned round by the fall of subterraneous waters; this wheel moves engines, that pump out the water from the bottom of the mines, up to the cavity, where this wheel is fixed; the water, which moves this wheel, falls no lower into the mines, but passes away thro' a *Cuniculus* made on purpose, thro' which, both this and the other water, pumped from the deepest parts of the mine, run out together at the foot of a hill: *Trinity* mine is 70 fathoms deep; built and kept open with under-work at a great expence; much of this mine, being in an earthy soil, its ore is much esteemed; several veins lie north, and other rich veins north-east; when two veins cross each other, they esteem it lucky; the several veins of ore keep not the same direction in the same mines; for if they did, it would be a help to discover them; but they have no certain way of knowing either which way they run, or where they lie; they use no *Virgula divina*, but dig always, as the adventurers desire: Dr. *Brown* was shewn a place, which they dug straight on for six years, tho' the ore was but two fathoms distant from the place where they first began; and in another place they dug for 12 years, and at last found a vein, which in a little time defrayed the charges.

The blackish silver ore is esteemed the best; much of it is mixed with a shining yellow substance, which, if not in too great quantity, renders the ore more easily fusible; but if it be in too great a proportion, they think it preys upon the silver in the mine, and sublimes it in melting, by making it too volatile; and therefore, they term it a *Robber*, as what spoils and takes away the richness of the ore: They often find a red

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ſubſtance, growing to the ore, called *Cinnabar*, *Cinnabar* of *Silver*, *Cinnabaris nativa*, *Minium nativum*, or *Berg-cinnabar*; this ſubſtance ground with oil, makes a vermilion, equal to, if not ſurpaſſing the cinnabar made by ſublimation; Dr. *Brown* diſcovered ſulphur in it, for throwing it on a hot iron plate, it burned blue; the miners ſay, they meet with no quickſilver, but they find cryſtals, amethiſts, or amethiſtine mixtures, in the clefts of the rocks, and ſometimes near, or joined to the ore; as alſo vitriol in ſeveral mines, and particularly in a mine, near *Paradiſe-Hill*, near *Schemnitz*, naturally cryſtallized in the earth.

As there is great variety in the ſilver-ore, as to its mixtures, ſo alſo in its richneſs; ſome containing a great proportion of ſilver in reſpect of others; 100 pound weight of ore ſometimes yields but ½ ounce, or an ounce of ſilver; ſometimes 2, 3, 4, 5 ounces to 20; richer ore is very rare; yet, there has been ſuch as contained half ſilver, and ſome ſo rich, as to be cut with a knife.

A ſpecimen of each ſort of ore is carried to an office, called the *Probierer*, who is to prove and judge of its richneſs, and which he does in this manner; he takes the ſame quantity of the different ores after firſt drying, burning and grinding them; he gives an equal proportion of lead to each, and then he melts and purifies them; and by exact ſcales, he obſerves the proportion between the ore and its contained metal, and reports it to thoſe employed in the great melting furnaces: If the ore be found to contain 2 ½ ounces, or more of ſilver, to 100 pound weight, they ordinarily melt it, without any previous preparation by the help of iron ſtone, called *Kys*, a ſort of pyrites which is not iron ore, but a ſtone found thereabouts, of which the liver-coloured is the beſt; and *Slacken*, a ſcum, or cake taken off from the top of the pan, into which the melted mineral runs: If the ore be poorer, containing only 2 ounces or leſs, to 100 pound weight, it is firſt pounded, and then much of the earthy parts are waſhed away, till it becomes richer, or has a greater proportion of metal, in reſpect of the ore; after which, it is thrown into the furnace, with the former materials; and the *Marcaſſite*, which remains ſtill with it, as ſinking always to the bottom with the ſilver in the waſh-works, promotes the quicker fuſion of the ore: All that melts in the *melting Furnace*, runs thro' a hole at the bottom thereof into a pan, placed in the earth before it, and thus expoſed, it immediately acquires a hard ſcum, droſs, loaf, or cake, which being often taken off, the remaining metal becomes purer; to which lead is added, and after ſome time, the melted metal is taken out; then, being again melted in the *driving Furnace*, the

lead, or what elſe remains mixt with the ſilver, is driven off by the blowing of two great bellows, and runs over in the form of litharge; that which firſt comes over, is the *white*, and that which comes over laſt, being longer in the fire, is the *red* litharge.

As *Chremnitz* gold ore has ſilver in it, ſo moſt of the *Schemnitz* ſilver ore contains ſome gold; which they ſeparate, by melting the ſilver, then granulating it, and after that, by diſſolving it in *Aqua-fortis*, whereby the gold is left at the bottom, and afterwards melted; the *Aqua-fortis* is diſtilled from the ſilver, and ſerves for uſe again.

The ſilver, then ſeparated from all its former mixtures, is ſent to *Chremnitz*, where they coin it into pieces of a mixt metal, which is the common money of the country, after this manner: They melt it with near the ſame quantity of copper, and run it into bars, which they beat out; then ſoftening theſe bars in the fire, they draw them out to an exact thinneſs, between two ſteel wheels; then they cut them into round pieces, with an inſtrument, like a ſhoemaker's punch; and after that boil them with tartar and ſalt, and ſhake them in a ſack with ſmall coals, and drying them in a perforated kettle; they are afterwards drawn between two wheels, in which they receive their ſtamp.

Of the principal Organ *of* Viſion; *by M.* Mariotte; *in anſwer to M.* Pecquet'*s Objections.* Phil. Tranſ. N° 59. p. 1201.

M. *Pecquet* objects, that if the *Sclerotica* and the *Choroides* be taken away from an eye, that is very freſh, and the *Retina* be left expanded on the vitreous humour, there is no ſeeing thro' this membrane, whence he concludes, that it is not ſufficiently tranſparent, to tranſmit ſo much light, as is neceſſary for viſion to the *Choroides*.

M. *Mariotte* thinks, there is good reaſon to doubt of this conſequence, ſince, there may be a great deal of difference between the *Retina* of a dead animal, after being expoſed to the air, and that of a living animal; for the *Tunica Cornea* of an eye, being held ſome time in one's hand, in a hot air, grows thick, and afterwards entirely opake; but that we may be convinced, that the *Choroides* is ſufficiently enlightened in a living animal, we muſt take the eye of an ox newly killed, while hot, and cut it in two, in ſuch a manner, that a good deal of the vitreous humour may remain extended on the *Retina*; then we ſhall obſerve diſtinctly thro' the *Retina*, the colours of the *Choroides*, the baſis of the optic nerve, the trunk of the little veſſels, which proceed from thence, and their diſperſion, with ſo much perſpicuity, that

that we cannot diſtinguiſh, whether there be a *Retina* beyond the vitreous humour, or not; hence, we may judge, that the light, which the objects ſend to the *Choroides*, is more than ſufficient for viſion, ſince, tho' much weakened by the reflexion, and by a ſecond paſſage thro' the *Retina*, and vitreous humour, it is yet ſtrong enough to form a clear and diſtinct repreſentation of the *Choroides* on our eyes; not that M. *Mariotte* denies the *Retina* to have ſome whiteneſs in a living animal, and that it is ſomething leſs tranſparent than the other humours, chiefly in that part, which is contiguous to the *Choroides*; and nature may have made it ſo on purpoſe to temper the brightneſs of greater lights, and to prevent dazling, in the ſame manner, as an inſenſible cuticle is ſpread over the ſkin, to hinder its being too eaſily hurt by ſurrounding bodies, and affected by the exceſs of heat and cold; but if he ſhould abſolutely deny, that the *Retina* has any opacity in a living animal, M. *Pecquet*'s experiment would not convince him, it being made upon a *Retina*, whoſe more ſubtile and tranſparent parts are evaporated; and he ſays, he might propoſe, for an example, a piece of white paper, thro' which, when wet, one ſees diſtinctly enough whatever is contiguous to it, but preſently reſuming its firſt opacity, when expoſed a little time to the air; and if this inſtance were not ſufficient, he ſays, he might alledge the little cryſtalline, found in the middle of the cryſtalline humour of many animals, which, being as tranſparent as the other humours of the eye, in a living animal, becomes, in two or three days after the animal's death, white and opake, tho' it be left in the eye, and the exterior cryſtalline remain ſtill tranſparent.

M. *Mariotte* thinks *Pecquet*'s ſecond experiment to prove the opacity of the *Retina*, which is to put it into water, to be very deceitful, for the *Hyaloides*, which envelopes the vitreous humour is perfectly tranſparent; yet if a part of this humour be put into water, the parts of the *Hyaloides*, which ſtick to it, will appear whitiſh, and thick, like a ſpider's web, tho' the vitreous ſtill retain its tranſparency; therefore, the putting the *Retina* into water, is not a ſufficient proof of its opacity in living animals, and no conſequence can be drawn from its ſtate in the air, to its natural ſtate; for the cryſtalline itſelf, becomes a little thick in water, and if it be left there ſome time, or expoſed to the froſt, it becomes white and opaque like ſnow: It is therefore neceſſary, in order to determine, whether the light of objects paſſes to the *Choroides*, or is almoſt entirely intercepted by the *Retina*, to adduce obſervations made on the *Retina* and *Choroides*, while

they are in their natural ſtate, as M. *Mariotte* did in the following experiment; he placed, in the night time, a candle very near his eyes, and cauſed a dog, at the diſtance of eight or ten paces, to look upon him; then he obſerved, in his eyes, a pretty ſtrong light, which M. *Mariotte* holds to proceed from the reflexion of the light of the candle, whoſe image is painted on the *Choroides* of the dog, which having much whiteneſs and luſtre, cauſes this very ſtrong reflexion; for if it proceeded from the chryſtalline or *Retina*, the ſame appearance would be ſeen in the eyes of men, birds, and other animals, who have the *Choroides* black, which we do not obſerve; it is therefore manifeſt, by this experiment, that the luminous rays paſs with a great deal of force, as far as the *Choroides*; and that the *Retina* receives very little impreſſion: Now this appearance happens in this manner; the little picture of the candle on the dog's *Choroides*, where the *Focus* of the cryſtalline and other humours lie, reflecting its rays back thro' theſe humours, makes its reciprocal *Focus* towards the candle, and conſequently, the eye, which is near the point, where theſe rays re-unite, ſhould ſee the dog's cryſtalline very much illuminated; there is another experiment to the ſame effect; place a round glaſs bottle, full of very clear water, at eight or ten paces from a candle, and put behind the bottle, at near the diſtance of its ſemidiameter, a white paper, in ſuch a manner, that one may ſee the light of the candle, which has paſſed thro' the bottle, re-united in a little ſpace upon the paper; then, they who have their eyes near the candle, will ſee the bottle full of light, which will diſappear, if the paper be held, either nearer to, or further from the bottle; and if one hold a ſmall lighted wax candle in the place of the paper, and you hold your eye, in the place of the former candle, you will ſee the bottle ſtill more enlightened than it was before; and one may eaſily judge, that the light, appearing in the dog's eye, proceeds from a like cauſe: The ſame experiment may be made in the eyes of ſeveral animals, and particularly of cats, in whoſe eyes, this light appears blueiſh, which ſhews, that it proceeds from their *Choroides*, which has much of this colour; but neither this colour, nor any other, which may be in the *Choroides*, cauſes any confuſion in the ſenſe of ſeeing, for the ſenſes receive no impreſſion from their own organs.

To the ſecond objection, *viz.* that the nerves are the organs of ſenſation, M. *Mariotte* anſwers, that according to his hypotheſis, the nerves are all coated with the *Pia Mater*, ſo that if theſe nerves be never ſo little moved, the impreſſion is conveyed to the brain by the continuity of theſe fibres: Now the *Choroides* is an expan-

expanſion of the *Pia Mater*, which envelopes internally the optic nerve, and which comes from the tuberoſity of the ſpinal marrow, by a continuity of fibres; whence it follows, that how little ſoever the *Choroides* be touched, the impreſſion may be eaſily communicated to the brain.

As to the trunks of the blood-veſſels, cauſing a defect of ſight at the inſertion of the optic nerve, M. *Mariotte* obſerves, that they are very ſmall, and that it is very hard to diſcern the little holes thro' which they paſs, when the nerve is cut off above its inſertion into the eye; and becauſe they often come out of the baſis by two ſeveral little holes, the diameter of each of which does not take up the ſpace of above $\frac{1}{8}$ of the diameter of the baſe, it follows, that if the reſt of the nerve were ſenſible of light, we ſhould not loſe ſight of a paper of two inches diameter at moſt, at ten foot diſtance.

M. *Mariotte* proceeds to confirm his opinion with ſome reaſons and obſervations, the firſt is, of the *Pupilla* dilating itſelf in the ſhade, and contracting again in a great light, and he thinks it hard to account for this involuntary motion, but on the ſuppoſition, that the *Choroides* is ſenſible of light; whereas, if the *Retina* be ſuppoſed the organ of ſight, it will be difficult to explain how this contraction is made: Again, the eyes of birds are ſo formed, that the optic nerve, after its inſertion into the eye, is inflected, and extends itſelf on the concavity of the *Sclerotica*, about the breadth of two or three lines, more or leſs, in proportion to the bigneſs of the eye; and the length of this inflection is covered by the *Choroides*, leaving but one little ſtreak in the middle, from whence the *Retina* takes its original, which extends itſelf on the *Choroides* over all the bottom of the eye; but is covered on the ſide of this white ſtreak, with a little black membrane, as long as the inflexion of the nerve, and almoſt as broad; which proceeds from the *Pia Mater*, and is, as it were, an appendix of the *Choroides:* And if you conſider the ſituation of this membrane, you will find it is near the axis of ſight, and that the rays of the objects, which birds look on with both eyes, fall preciſely upon it after their refraction: Since then, in that place, where viſion ought to be ſtrongeſt, the *Retina* is covered, and that no man doubts, but birds are more clear ſighted than other animals; it muſt be granted, that the *Retina* is not the principal organ of viſion, but that that preheminence belongs to the *Choroides*.

The

The Copper-Mine *at* Herrn-groundt *in* Hungary; *by Dr.* Edw. Brown. Phil. Transf. N° 59. p. 1042.

HErrn-groundt is a little town ſituated very high between two hills, at the diſtance of an *Hungarian* mile from *Newſol*; and in the town itſelf is the entrance into the copper-mine: The deep deſcents are made by ladders, or trees ſet upright, with deep notches or ſtairs cut in them; as the mine lies high in the hill, they are not troubled with water, but they are annoyed with duſt and damps: The veins of this mine are large, many of them unite, and the ore is very rich, a hundred pounds ordinarily yielding 20 pounds of copper, ſometimes, 30, 40, 50, and even to 60; a great deal of the ore is ſo faſtened in the rock, that it is ſeparated with great difficulty; it is of different ſorts; the chief are the yellow and the black; the former is pure copper ore; the latter contains a proportion of ſilver: Here is found no quickſilver: The *mother* of the ore is yellow; and the copper ore heated and thrown into water, makes that water reſemble ſome ſulphureous baths: The metal is ſeparated with great difficulty from the ore, commonly paſſing 14 times thro' the furnace; ſometimes it is burned, at other times melted either alone, or with mixtures of other minerals, and its own droſs: Several ſorts of vitriol are found in this mine, as green, blue, reddiſh, and white; there is alſo a green earth, or ſediment of a green water, called *Berg-grun*; here are ſtones of a beautiful green and blue colour, and one ſort on which *Turcoiſes* have been found, and therefore called the *Mother* of the *Turcois:* Deep in the mine are two ſprings of a vitriolate water, called the old and new *Zimeut*, ſaid to turn iron into copper, after continuing in it ordinarily for 14 days; Dr. *Brown* took out of the old *Zimeut* ſeveral pieces, which were formerly iron, but appeared then to be copper; they are hard in the water, and do not wholly loſe their figure; they fall into powder, and eaſily melt without the addition of any other ſubſtance; of this copper, they make handſome cups and other veſſels.

Baths, &c. *in* Auſtria *and* Hungary; *by the Same.* Phil. Tranſ. N° 59, p. 1044.

AT *Baden* in *Auſtria*, four *German* miles to the ſouth of *Vienna*, and ſituated in a plain, near a ridge of hills, are convenient baths; two within the town, five without the walls, and two beyond a rivulet, called *Swechet*; the *Duke*'s bath, which is the largeſt, is about 20 foot ſquare, in the middle of a houſe

a houſe of the ſame figure, built over it; the vapour is diſcharged thro' a tunnel of wood at top; and the water is conveyed into the bath from the ſpring-head, which riſes at a little diſtance to the weſt, thro' wooden pipes, that run under the town walls; the ſprings of the other baths riſe under them, being let in thro' holes in the flooring, for the ſeat, ſides and bottoms are made of fir; the water, for the moſt part, is clear and tranſparent, yet ſomewhat blueiſh, and makes the ſkin appear pale in it, juſt as the ſmoke of brimſtone does; it turns metals black in a few minutes, except gold, whoſe colour it heightens: The coin of this country, which is a mixture of copper and ſilver, is in a minute changed from a white into a dark yellow, and ſoon after becomes black; it imparts a fine green colour to the moſs and plants, which it waſhes, and often leaves a ſcum upon them, of a purple mixed with white; as it runs from the ſpring-head, it ſomewhat reſembles the ſulphur river in the road from *Tivoli* to *Rome*, but is not ſo ſtrong nor ſtinking, neither does it incruſtate its banks: The ſpring head, riſes under a rocky hill, about the length of 40 yards, thro' an arched paſſage cut in the rock, and which is a natural ſtone, like that of *Tritola* and *Baiæ*, made by hot bath-water running under it; the greateſt part of this cave is incruſtated with a white ſubſtance, called ſaltpetre, at the mouth of the cave it becomes harder and more ſtony: Upon opening ſome of the pipes, that convey the water, on the upper part was found a quantity of fine ſulphur in powder like flowers of brimſtone; *Oleum Sulph. per campanan* dropt into this water cauſes no ebullition, as *Oleum Tart. per deliquium* does: The ſecond bath within the walls, is that of *Our Lady*, about 12 foot broad and 24 long; one end of it lies under a church of the ſame name; it abounds more with ſulphur than the others, is bluer and leaves a yellow flower on the boards, as the others do a white: The third is the *new Bath*, without the town near the gate: The fourth the *Jews Bath*, with a partition in the middle to ſeparate the men from the women: The fifth St. *John*'s *Bath*, is of a triangular form: The ſixth is called the *Beggar*'s *Bath*, which is always ſo ſhallow, that they lie down in it: The ſeventh the *Bath* of the *Holy Croſs*, about two fathoms ſquare, chiefly allotted for the clergy: The eighth St. *Peter*'s *Bath*, is greener than the others: The ninth, the *Sour Bath*, is ſet about with balaſters, and covered with a cupola and lanthorn, the water is very clear, the ſteam of this bath colours money black, and yet, when once cold, it

changes

changes not the colour of metals, tho' boiled in it: The hottest of these baths exceed not the heat of the *Queen*'s *Bath* at *Bath* in *England*: They use no guides as with us, but direct themselves with a short turned staff.

At *Manners-dorff*, situated under a hill, on the east side of the river *Leyta*, there is only one bath, rising under a church, built over the spring-head; its water is luke-warm, and if wanted hotter, they boil it in great coppers, and bathe in tubs filled with it; from that substance, which sticks to the coppers in boiling, it appears to be impregnated with sulphur, salt-petre and chalk, it tinges the stones in it of a fair green, like a *Turcois*, and its steam, which sticks to the moss under the church, turns into drops of gold or amber.

At *Dotis*, two *Hungarian* miles from *Comorra* in *Hungary*, are sulphureous baths, said to be warm in winter; in *March* and *October* Dr. *Brown* found their warmth to remit very much, and to be scarce perceptible; they are of a blueish colour, and of an acid taste: The *Queen*'s *Bath*, and the *Great Bath* rise in a marsh, to the north of the castle: There is another bath in the governor's garden, within the town; they are used as those of *Manners-dorff*.

At *Banka*, two *Hungarian* miles from *Freystadt*, are 15 baths in a meadow; and there have been more, but the river *Waag*, by eating away the banks, has swallowed them up, and it has broke in into 3 of the 15; the water is like that of *Baden* in *Austria*; it leaves a white sediment on the moss and places it washes, it tinges metals black; upon sticking some money into the ground, over which the water runs, the part in the ground retained its own colour, and the other in the water became coal-black; these baths are open and very hot.

The baths at *Boinitz*, near the river *Nitre* in *Hungary*, are of a moderate gentle heat, much beautified by count *Palfi*, palatine of *Hungary*, and all of them covered under one roof; the first is the nobleman's bath, built of stone, and the descent into it on all sides is by stone-stairs, there are four more of wood, but handsomely and well built.

At *Stuben*, three *Hungarian* miles from *Newsol*, and two from *Chremnitz*, near a rivulet, are 7 baths in great esteem; their water is clear, and smells of sulphur, and the sediment is green; it colours the wood over it green and black, but changes not the colour of metals so soon as most of the others; the springs rise underneath, and run thro' the holes in the flooring of the baths; their heat is equal to that of the *King*'s *Bath* in

in *England* they lie in a plain, encompaſſed on all ſides with hills, the neareſt to them are thoſe to the eaſt, which on the other ſide are rich in metals.

At *Glaſs-hitten*, an *Hungarian* mile, or about 7 *Engliſh* miles from *Schemnitz*, are 5 baths; the water depoſites a red ſediment, and incruſtates the wood and ſeats under it with a ſtony ſubſtance, it likewiſe gilds ſilver: The moſt remarkable of theſe baths is that called the *Sweating Bath*, whoſe ſprings ouſe thro' a hill, and fall into a bath built to receive them; at one end, is an aſcent into a cave, which is become a noble ſtove by the heat of theſe waters, and the ſeats in it are ſo diſpoſed, that by ſitting higher or lower, you may regulate your ſweating, and have what degree of heat you pleaſe; this cave as alſo the ſides of the bath are covered, by the continual dropping of theſe hot ſprings, with a red, white and green ſubſtance; the red and green make the beſt ſhow, but the white is uſed againſt the ſtone, it cures ulcers and ſore backs in horſes.

There are alſo hot baths at *Eiſenbach*, about 4 *Engliſh* miles from *Glaſ-hitten*, and 5 or 6 from *Schemnitz*; great trees, placed at the top or ſurface of the water in theſe baths, have been petrified; here are two convenient baths, much frequented; and a third, which is made by the water let out of the former, called the *Snake*'s *Bath*, from the number of ſnakes coming into it, when filled with theſe warm waters.

The natural baths of *Buda* are eſteemed the nobleſt in *Europe*, not only in reſpect of the large and hot ſprings, but the magnificence of their buildings; for the *Turks* bathe much, and tho' little curious in moſt of their private houſes, yet are they very ſumptuous in their publick buildings, as appears from their *Chans* or *Caravanſera*'s, *Mosks*, *Bridges* and *Baths*; Dr. *Brown* obſerved 8 *Baths* at *Buda*, 3 to the eaſt and ſouth-eaſt of the city, in the road to *Conſtantinople*, and 5 to the weſt end of the town, in the road to *Old Offen* and *Strigonium*: The firſt is a large open bath at the foot of a high rocky-hill, formerly called *Purgatorium*, and of which the people have ſome odd and ſuperſtitious notions: The ſecond is covered with a cupola, ſtanding nigh the ſame hill, but more into the city, and near a place where they tan: The third is called the bath of the green pillars, tho' at preſent, *viz.* 1669, of a red colour; and it ſtands over againſt the *Caravanſera*; its water is hot, but ſufferable without the addition of cold water; it is impregnated with a petrifying juice, which diſcovers itſelf on the ſides

of the bath, the ſpout and other places, and makes a grey ſtone; the vapours reverberated by the cupola, by the irons extended between the columns, and by the capitals of the pillars, form long ſtones, like icicles, hanging from all theſe places, like what is obſerved in many ſubterraneous grotto's, and particularly in *England*, as in *Okey-hole* in *Somerſetſhire*, and *Poole*'s-*hole* in *Derbyſhire*.

The baths of the weſt end of the town, are 1. *Tactali* or the *Bath of the Table*, a ſmall covered bath, the water is white and of a ſulphurous ſmell; they drink of this as well as bathe in it; what they drink, they receive from a ſpout, that conveys the water; upon giving a *five Sols* piece to a *Turk*, who was bathing in it, by rubbing it between his fingers, while the hot water fell from the ſpout upon it, it was gilded in a minute. 2. *Barut Degrimene*, or the bath of the *Powder-mill*, riſes in an open pond near the high-way, and mixes with the freſh ſprings; ſo that the pond is of a whitiſh colour in one part, and clear in the other, as alſo cold and hot in ſeveral places; this being conveyed croſs the high-way into a *Powder-mill* is uſeful in making of powder; they are of opinion here, that this bath communicates with the ſulphurous ſprings at *Dotis*, many miles diſtant. 3. *Cuzzoculige*, the little bath, or the *Bath of the Saint*, is kept by *Turkiſh* monks; the bath, where the ſprings ariſe, is ſo hot as ſcarce to be endured; but, being let out into another bathing place at ſome diſtance, becomes ſufferable and fit for uſe; this water has neither, colour, ſmell nor taſte, different from common water, only the ſides of the bath are green, and have a fungous ſubſtance all over, and it depoſites a ſediment. 4. *Kaplih*, a very noble bath; the water is very hot, and endued with a petrifying quality; the buildings about it are 8 foot ſquare, with a noble bath in the middle, and a trench of water round about it for the greater ornament; on every ſide is a niche, wherein is a fountain; in the middle of the anti-chamber, where they that bathe leave their cloaths, is a fair ſtone-baſon and a fountain. 5. The bath of *Veiibey*, the nobleſt of all, which has a ſtrong ſulphurous ſmell, and a petrifying virtue, is ſo hot, that to make it ſufferable, it requires the addition of cold water; the anti-chamber is very large, the bath-room capacious, and high arched, and adorned with five cupola's, over the great round bath in the middle is a very beautiful cupola, and leſſer ones over each of the four corners, in which there are baths or bath-ſtoves for more private uſe; in theſe the *Turks* take of the hair of

their

their bodies with a *psilothrum* or depilatory mixt with ſoap, for they wear no hair but on their beards, and a lock on the crown of their heads; the great cupola is ſupported by twelve pillars, between eight of which are fountains of the hot water, and between the others are places to ſit down, where the barbers and bath-men attend; and in each of theſe places are two ciſterns of free-ſtone, into which are conveyed hot bath-water, and likewiſe cold water, to be mixt and tempered to every one's mind: The men bathe in the morning, and the women in the afternoon; when any one intends to bathe, there are ſeveral ſervants attending, who furniſh a cloth and apron; then the perſon ſtrips, and putting on the apron, he enters the ſecond room, in which is the great bath, and ſits on its ſide, or between the pillars, near a fountain; where the barber ſtrongly rubs him with his palm, ſtretching out his arms, and lifting them up, after which the party bathes; then, if he is a ſubject of the grand ſeignior's, or, if it be the cuſtom of his country, his head is ſhaved, and if a young man, his beard, except the upper lip; next the barber rubs his breaſt, back, arms and legs with a hair-cloth; then he waſhes his head with ſoap, and after that throws cold water upon him, and then the party walks about for ſome time in the ſteam of the bath: Theſe baths are uſed two ways, either by entring into the water, or ſitting in the ſteam, for the vapours make the whole room a ſtove, and provoke ſweat.

On the north ſide of mount *Calenberg*, two *German* miles from *Vienna*, are ſtones markt with trees and leaves; in the hermitage of the *Camaldulenſes*, ſituated on a peak of this hill, the walks in the gardens were paved with beautiful ſtones of this ſort.

Not far from *Manners-dorff*, is the emperor's quarry of ſtone, of which the beſt buildings in *Vienna* are made; whereever there is a chink, or ſeparation of one ſtone from the other, the water falling between them, petrifies, and makes a kind of a ſtony *callus*.

An *Engliſh* mile from *Freyſtadt* in *Hungary*, is a quarry of ſtone, out of which many great ſtones are dug, which are tranſparent and reſembling ſugar-candy.

At *Banca*, two *Hungarian* miles to the north of *Freyſtadt*, is a quarry of white ſtone, near the hot baths of that place; over which, a layer of chalk, of about a yard thick, which is very beautiful to the eye, being of all colours, except green; and ſo finely mixt, ſtreaked and ſhaded, that it ſurpaſſes

marble-paper, and the water, dropping upon it, does, as it were, varnish it.

At *Schemnitz* in *Hungary*, famous for silver-mines, is a high perpendicular rock, part of which, from top to bottom, is naturally tinged with a shining fair blue and green, and it is said, that there is a rock like this, near the silver mines of *Peru*.

The mountain of *Clissura*, a part of mount *Hemus*, as also mount *Pyrlipe* shine like silver, which is owing to the great quantity of *Muscovy* glass, in which they abound: Near *Spital* in upper *Carinthia* are talc-rocks; a hill near *Sarvizza*, two days journey on this side *Larissa*, affords an earth of a fine red, of which the earthen vessels of that country are made.

The Spanish Sembrador, *and its Uses*; *by* Don Joseph de Lucatello. Phil. Transf. N° 60. p. 1056.

BOTH ancient and modern husbandmen have agreed that the perfection of agriculture consisted in setting the plants at proportionable distances, and giving sufficient depth to the roots, that they may spread to receive that nourishment from the ground, which is necessary to produce and ripen the fruit; but this has been so far from being observed, that all sorts of seeds are sown by handfuls at random; whence it happens, that corn is sowed in some places too thick, in others too thin, and the greater part of it either not covered, or not deep enough; whereby, it is not only exposed to be eaten by birds, but also in cold countries to be spoiled by frost, and in hot regions, by the sun; on these considerations, *Don Joseph de Lucatello* invented an instrument, which, being fastened to the plough, at once ploughs, sows and harrows; whereby, the sower's labour is saved, and the grain, falling in order, and in the bottom of the furrow, remains at the same distance under ground, so that, in five parts of seed, four are saved, and the increase becomes incredible; This instrument was made trial of before his catholic majesty in the *Buen Retiro*, where it answered expectation; an ordinary husbandman, sowed in a measured space of ground in the common manner, and reaped 5125, but, sowing by this instrument in an equal quantity of ground, he reaped 8175, besides the seed saved in the sowing; there was another trial made of this instrument before his imperial majesty in the fields of *Luxemburg* in *Austria*, where the increase is usually four or five fold, but the crop from the ground sowed with this instrument was sixty fold, as appears by a certificate given at

Vienna

Vienna Aug. 1ſt, 1663 N. S. by an officer of the emperor, appointed to ſee the ſaid ground ſowed and reaped.

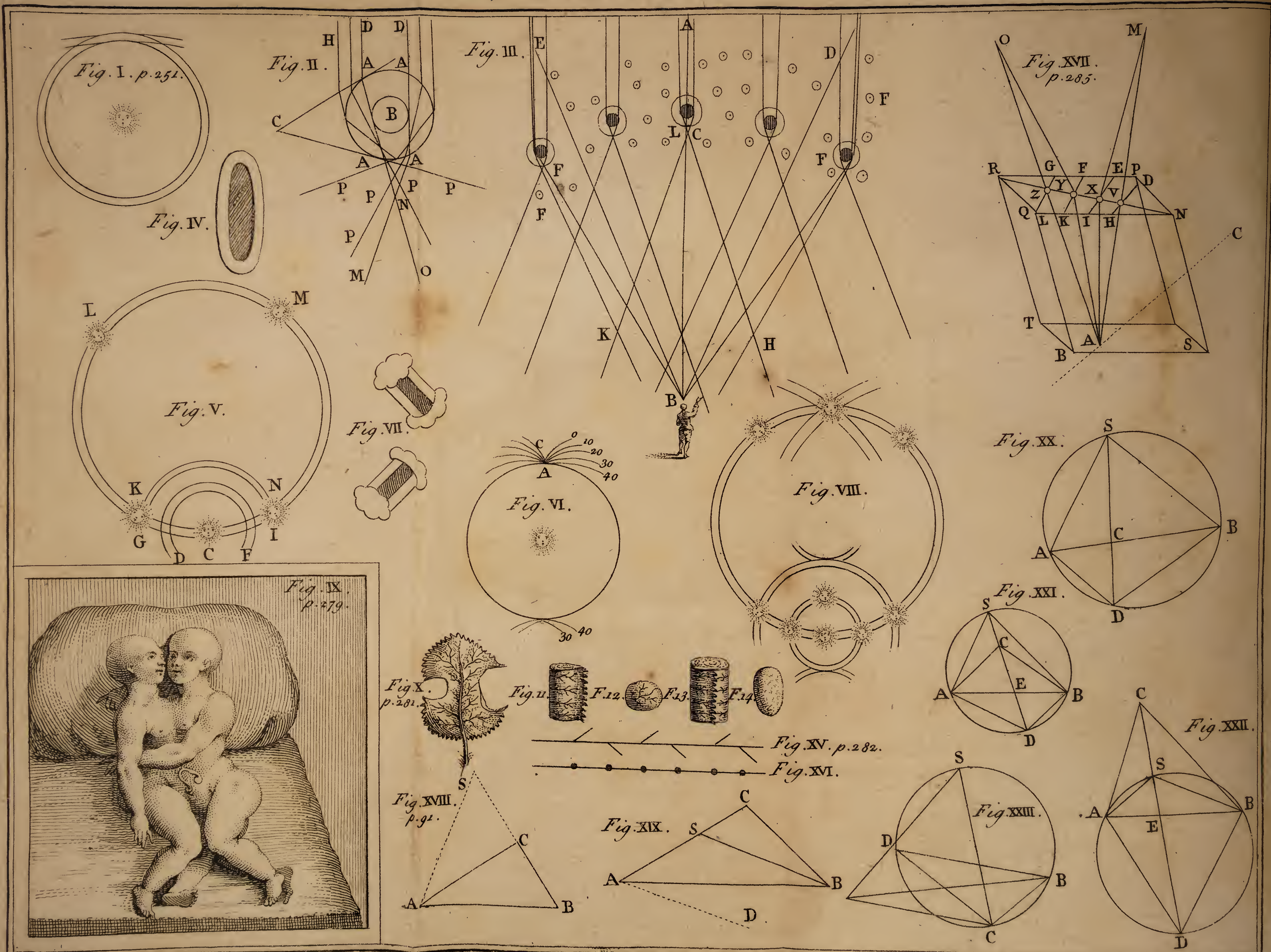
Fig. *6*. Plate VIII. is a box of wood; *abcd*, the cover of that part, into which the corn is put, which is open in Fig. 2. at W; *efhgkl* the two ſides, that cover that part of the box, where the cylinder, which is ſtuck round with three rows of little ſpoons, is moved about to throw out the corn, which ſides are taken of in Fig. 7. that the cylinder R S and the ſpoons *xxx* may appear; the internal ſhape of theſe ſides is expreſſed Fig. 8. where may be ſeen the four triangular pieces *pppp*, with the triangular interſtices *qqq*, which ſerve to convey the corn, carried up in the ſpoons, and diſcharged at the top of the cylinder, to run out of the holes underneath the box; T is one of the wheels; U the other end of the cylinder, on which the other wheel is to be fixt: This *Sembrador* muſt be tied faſt to the plough, as in Fig. *9*. ſo that the corn may fall in the furrow, and at the turning of the plough, its ears may cover the corn of the laſt furrow with earth; becauſe the ſeed ſown by this inſtrument is ſet at a convenient depth, *viz.* in the bottom of the furrow, whereas, that ſown the common way, remains nearer the ſurface of the earth, or quite uncovered; it muſt of conſequence ſhoot ſomewhat later; ſo that it is requiſite, the husbandman uſing this inſtrument, ſhould ſow 8 or 10 days ſooner than the uſual ſeed-time, *viz.* begin to ſow in the middle of *September*, and make an end of it in the middle of *November*: In ſtiff ground, the furrows may be 5 or *6* inches deep, in light and ſandy ground 7 or 8 inches, and in a mean ſort of ground *6* or 7: Care muſt be taken that the wheels on the ſides of the inſtrument do always turn round, and never drag along, without turning; as alſo, that the ears of the plough be made ſomewhat bigger than the ordinary ones: It is alſo proper that the ſeed be well ſifted and cleaned, that ſo the little ſpoons may every time take up a grain, and the ſeed be better diſtributed: In barley it is to be obſerved, that it be made ſo clean, that the ſtraw and beards be broken off, as near the grain as poſſible, that they hinder not the grain from coming out of the inſtrument: After ſeed-time, furrows muſt be made to drain the land of water; before the ground is ſown, it muſt be eared as often as is uſual in the ſeveral countries: When you deſign to ſow, the ploughman muſt begin to open a furrow with the plough for one or two paces; and when the plough is in the ground, at a convenient depth, then tie the *Sembrador* to the plough-beam, ſo that the nails in the

wheels

wheels may ſtand on the ground to make them turn round: The ears of the plough are to be made larger than ordinary; for in that caſe, they will cover the furrows better, when ſown, and make wider furrows to receive the ſeed; ſuch large ears will prevent the blows, the great clods and ſtones will give the *Sembrador*; and if theſe are not ſufficient, you muſt add another pair of ears to the plough, four or five inches higher than the firſt, and a little behind them, and thus the *Sembrador* will be entirely defended; and theſe ſecond ears, are to be of the ſame bigneſs with the firſt: The time of ſowing, according to the moſt experienced farmers, is when the mould is dry, or but little inclining to moiſture: In either of which caſes, this new *Sembrador* works, without clogging the wheels, or ſtopping up the holes with dirt, thro' which the grain is to iſſue: When this *Sembrador* works as it ought to do, it will ſow 3 *Celamines*, or about a peck of wheat, and 5 *Celamines* of barley, on as much land, as would take up about a buſhel and a half, after the common way of ſowing: And if it much exceed or fall ſhort of this proportion, it ſhews ſome fault in the inſtrument, or careleſneſs in the ploughman: The ſpoon muſt be made proportionable to the bigneſs of the ſeed: The furrows muſt be ploughed very cloſe to each other, that the plough, when it returns, may the better cover the laſt furrow, which is left open, and ſowed as it came along: After having ſown the land, it ſhould be made as plain as poſſible, and without any furrows to carry off the water, as is uſual; it being ſufficient to make furrows at the diſtance of every fourth yard; and it is found by experience, that land, laid up without furrows, bears more corn, than that which has more furrows, becauſe wheat and barley, and other plants, receive the greateſt damage by drought; and therefore, this ought more eſpecially to be obſerved in *Spain*, one of the dryeſt countries in *Europe:* In ſeveral parts of *Spain*, in 1664, it was found, that land ſown in *September* has yielded a better crop, than that ſown in *October*; and that in *October*, better than that in *November*; which ſhews, that it is more advantageous to ſow early than late: It is obſerved, that what is ſown in the new moon, ſhoots forth, thrives and ripens ſooneſt: In *Spain*, *Italy*, and the iſlands of the *Mediterranean*, they may begin the firſt new moon in *September*, and end with that of *November*; but in *Germany*, and the *Low Countries*, they begin in the end of *Auguſt*, and end with the new moon of *October*.

A Halo

PLATE. IX.



G. S. del. Hulett Sculp.

A Halo *at* Paris, *and the Causes of* Halo's *and* Parhelia's; *by M.* Huygens. Phil. Transf. N° 60. p. 1065.

MAY 12th, 1667, the philosophical society at *Paris*, observed a halo or circle about the sun, whose diameter was 44°, and the breadth of its limb, about half a degree; the upper and lower parts were of a vivid red and yellow, with a little purple colour, but especially the upper; the red was within the circle; the other parts appeared whitish, and not very clear: The space within the halo, was a little darker than that about it, especially towards the colour'd parts: There was also a portion of another great circle, which touched the halo above, and whose extremities were bent downward, as in Fig. 1. Plate IX. this circle had also its colours, like those of the halo, but fainter: The height of the sun, at the beginning of the observation, was about 46°. There were in the air a few white clouds, which tarnished a little the blue azure colour of the heavens, and lessened the sun's brightness, which shone, as in an eclipse: The weather was cold, considering the season of the year; and it was said, that it had freezed the preceeding night. This halo appeared in the same beauty and splendor of colours, from nine in the morning, when it began to be observed, till about half an hour past ten; after which time, it became gradually fainter, till two in the afternoon, when it ended, after resuming a little more vigour before its disappearance.

This phænomenon engaged M. *Huygens* to account for the cause, both of halo's and parhelia's: Halo's, according to him, are formed by small round grains, consisting of two parts, one transparent, the other opaque, the latter being inclosed in the former, as a cherry-stone in a cherry; thus Fig. 2. A A represents one of these grains, and B, the kernel, or opake part; and these grains, floating up and down in the air, between us and the sun, necessarily intercept his rays, which falling on the grains, form a space of a conical figure behind them, as M N O, Fig. 2. in which the spectator's eye being situated, cannot see the sun thro' that grain, tho' it may see him, when posited elsewhere, as in P; and to make this the more intelligible, in Fig. 3. B is the place of the eye; B A, the axis passing from the eye to the sun; C M F, some of the icy grains with their kernel, which makes them half opake; the grain C, being in the axis B A, and the lines C K, L H, representing the rays of the sun nearest the axis, whose passage is not hindred by the opacity of the kernel, it is certain, not only, that the grain C will not be able to transmit any ray

towards

towards B; but alſo that, imagining the ſurface of a cone, whoſe vertex is in the eye, and ſides B D, B E, parallel to the rays C K, L H, all the grains M M, comprehended within this ſurface, will not ſuffer any ray to paſs to the eye, becauſe it muſt be in their cone of obſcurity; but the grains F F, without that ſurface, will let them paſs; becauſe the eye is out of their cone of obſcurity; whence it follows, that the angle of this cone B D E, is that, which determines the diameter of the halo, which depends on the proportion the opaque grain has to the tranſparent, in which it is incloſed: For, if this diameter be of 44°, as is obſerved in moſt halo's, the bigneſs of the opaque grain, will be to the tranſparent, as 40 to 19: But he obſerved, that this proportion was not always the ſame, and that its diverſity was the cauſe, that ſometimes, there were ſeen many halo's, one about the other, and all of them having the ſun for their centre: He added, that it was eaſy to account for the round figure of theſe halo's, whether the ſun be much or little elevated above the horizon; as alſo to give a reaſon of their colours, which is the ſame with that in triangular glaſs priſms, as is evident from the tangents A C, drawn to the grain A, at the points, where the ray D A enters, or comes out: He further obſerved, that it was alſo manifeſt, why the red colour is in the interior circumference of the halo, and why the ſpace, it takes in, and chiefly, near the moſt lively coloured parts, appears obſcurer than the ambient air, becauſe the grains are there in greateſt numbers, and ſo tranſmit none of the ſun's rays to the eyes: As to parhelia's, and the circles that always accompany them, M. *Huygens* affirmed, there were formed in the air, certain little cylinders, of the ſame nature with the above grains, and which were oblong icy grains, Fig. 4. and rounded at each extremity; and that the internal kernel was of the ſame ſhape, and that from their different diſpoſitions, all the appearances of the parhelia and their circles, did neceſſarily follow; and that ſome of theſe cylinders being erect, there muſt appear in the heavens a great white circle, parallel to the horizon, paſſing thro' the ſun, and nearly of the ſame breadth with him, as was obſerved in the phænomenon of *Rome*, *Anno* 1629, repreſented here by Fig. 5. this circle L K N M is cauſed by the reflection of the rays of the ſun on the ſurface of theſe cylinders; it being eaſy to demonſtrate, that none, but thoſe, elevated at the ſame angle above the horizon with that of the ſun's height, can reflect his rays to our eyes; whence it plainly follows, that it muſt appear white, and of the ſame altitude with the ſun, and conſequently parallel to the horizon; theſe erect cylinders form,

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on each ſide of the ſun, a parhelion in the great white circle, as was obſerved at *Rome*, and marked K and N; theſe parhelia have commonly luminous tails, becauſe the cylinders, which follow thoſe that form the parhelia, and which are at a greater diſtance from the ſun, tranſmit his rays to the eye; ſo that theſe tails may be 20° and upwards, in length; the parhelia are always coloured, becauſe produced by refraction like the halo: Beſides, there are two other images of the ſun, generated by theſe perpendicular cylinders, and ſo diſpoſed in the great white circle, that the ſpectator turning his face towards the true ſun, has them behind him, as the parhelia L and M at *Rome*; and they are produced by two refractions, and one reflexion in the cylinders, in the ſame manner as the rainbow in the drops of water; ſo that the opake kernels contribute nothing to the production of the two ſuns; and they may be ſometimes ſo big as to intercept the ſight of them; according to the greater or leſs altitude of the ſun, the two parhelia are at a greater or leſs diſtance from each other: The ſame perpendicular cylinders may alſo produce a halo about the ſun, on account of the rounding of their two extremities, and theſe halo's are probably thoſe which are generally ſeen to paſs thro' the two parhelia, on each ſide of the true ſun, as the halo G K N I in the phænomenon at *Rome*: Some of theſe cylinders are alſo parallel to the horizon, and in different directions; and this horizontal poſition is very natural to theſe cylindrical bodies, ſupported by the vapours ariſing from the earth: And in theſe cylinders, the arches, which touch the halo's above or below are formed, as in the phænomenon at *Rome Anno* 1630, deſcribed by *P. Shenir*; as alſo in all thoſe by M. *Hevelius*, at the end of his *Mercurius in Sole*; and the arch, which appeared on the laſt halo at *Paris*, was of the ſame kind: The figure of theſe arches is different, according to the different altitudes of the ſun, and different diameters of the halo's: When the ſun is very near the horizon, ſuch an arch appearing on an ordinary halo of 44°, muſt repreſent, as it were, two horns, Fig. 6. A B, A C; but the ſun riſing higher, the horns become lower in proportion, and make ſuch arches as are repreſented in the ſame figure, where each height of the ſun is marked near the arch it is to make: Where the arches touch the halo's, that part being more ſtrongly enlightened and coloured than the reſt, makes it probable, that there are parhelia in thoſe places: And the reaſon, why theſe arches do generally produce a parhelion, is that both the arch and parhelion are produced by the ſame parallel cylinders, as was the caſe in the laſt parhelion at

 Paris;

Paris; and this ſeemed to be confirmed by the greater degree of brightneſs in the ſuperior and inferior part, than any where elſe; whereas, when produced by the round grains, it muſt appear all over equally ſtrong; theſe parallel cylinders account alſo for the *White-Croſs* obſerved, together with the *Paraſelenæ*'s or mock-moons, by M. *Hevelius*, and exhibited at the end of his *Mercurius in Sole*; the perpendicular fillet of that croſs is produced by the reflexion of the moon's rays on the ſurface of theſe cylinders; as the other fillet, parallel to the horizon, is by the reflexion of the perpendicular cylinders, which form the great white circle, of which this fillet is a part; and that the parallel cylinders may produce this effect, the moon muſt not be very high above the horizon: Beſides the perpendicular and parallel cylinders, there are others moving in the air in all manner of poſitions, and theſe muſt produce a halo about the ſun, on the ſame account that the round grains do, and even a more vivid one, in regard each cylinder ſends more rays to the eye, than each of the little ſpheres; and the ſmall halo D E F, in the *Roman* phænomenon, Fig. 5. may very well have been produced by ſuch cylinders: As to thoſe mock-ſuns, that ſometimes appear directly oppoſite to the true ſun, ſuch as was obſerved by M. *Hevelius*, *Feb.* 13, 1661, he could find nothing, either in the round grains, or in the cylinders, which ſhould make theſe ſuns neceſſarily meet in the great white circle, parallel to the horizon; and if it ſhould be verified by future obſervations, its cauſe muſt be looked for elſewhere: In the *Anthelion*, obſerved by M. *Hevelius*, *Sep.* 6, 1661, there were two coloured arches of a circle, oppoſite to the ſun, interſecting each other, and their interſection was the place of the mock-ſun; which, tho' repreſented in *Hevelius*'s figure, at the ſame height with the true ſun, yet it was in reality higher by 15° or more; ſo that, if there had been a great white circle in this phænomenon, there would be no parhelion in it: For the generation of theſe ſuns, M. *Huygens* ſuppoſed a number of ſmall cylinders, with opaque kernels, like the preceeding, but ſwimming in the air in an inclined poſition to the horizon, at a certain angle, near half a right angle; for which effect, the cylinders *Des Cartes* obſerved to fall from the heavens, with ſtars at both ends were particularly appropriated; as may be ſeen experimentally, by forming cylinders of that ſhape, repreſented Fig. 7. and letting them deſcend in air or water; and theſe cylinders accounted not only for the *Anthelia*, made by the interſection of two arches, as in Fig. 8. but alſo, for ſome other extraordinary arches and rods ſometimes obſerved near the ſun. In order to

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make the effect of those cylinders manifest, M. *Huygens* exposed to the sun, a cylinder of glass a foot long, of the shape of that in Fig. 4. with an opaque cylinder of wood in the middle, and the ambient space filled with water; the eye being put in all the requisite situations, there were successively seen the several refractions and reflexions observable in parhelia, and their circles: It were to be wished, for the confirmation of this hypothesis, that some of those small cylinders could be observed to fall to the ground at the time of any parhelia; but M. *Huygens* shewed, that that could not easily be done, because the vapours arising from the earth, which produce their cylindrical figures, keep them suspended in the air.

Deaf *and* Dumb Persons *taught to speak and understand a Language; by Dr.* Wallis. Phil. Transf. N° 61. p. 1087.

THIS task consists of two very different parts, which mutually render each other more difficult; for besides the teaching a person who cannot hear, to pronounce the sound of words, there is the other difficulty of making him understand a language, and know the signification of those words, whether spoken or written, whereby, he may both express his own thoughts, and understand those of others: We find by experience, that the most advantageous way of teaching a child his first language, is by conversation; but as this method is entirely excluded by deafness; so on the other hand, the want of language, makes it more difficult to teach him how to pronounce the sounds: And there being no other way to direct his speaking, than by teaching him the several motions of the tongue, lips, palat, and other organs of speech, in the forming of sounds, that he may pronounce by art, what others do by custom; the difficulty is still encreased, as these motions are so very nice and delicate, and the difference in forming sounds so very subtile, that most who pronounce them every day, cannot account for their formation, much less teach another; and if it be thus difficult by writing, to give instructions to one, who understands a language, the difficulty must needs be encreased, when there is no other language to express it in, but that of dumb signs: As to the first difficulty, *viz.* that of teaching to pronounce the sound of words, tho' the ear guide the tongue in speaking, as the eye does the hand in writing, and therefore, such as by accident lose their hearing, lose also their speech, and consequently become dumb as well as deaf; yet it is possible to make the organs of speech observe their due postures and motions, tho' the ear discern not the sound; and as

to the ſecond difficulty, that of underſtanding a language, the eye may apply complications of letters, or other characters, to repreſent the various conceptions of the mind, with the ſame eaſe that the ear does a like complication of ſounds; and tho' it be true, that letters are the immediate characters of ſounds, as theſe ſounds are of conceptions, yet there is no impoſſibility in letters and characters, being as properly apply'd to repreſent *immediately* our conceptions, as *mediately*, by the intervention of ſounds; and this is done every day, not only by the *Chineſe*, whoſe language entirely conſiſts of ſuch characters, as repreſent things and notions, independently of ſounds; but alſo in numeral figures among us, which an *Engliſhman* pronounces, *one*, *two*, *three*, &c. a *Frenchman*, *un*, *deux*, *trois*, &c. and the ſeveral characters of weights and metals, are likewiſe uſed by different nations to repreſent the ſame conceptions, tho' expreſſed by different ſounds; and, in ſpecious arithmetic, the ſymbols convey the very ſame notions, tho' the expreſſion of them be as different, as the ſeveral languages that are ſpoken: And not to diſpute now the poſſibility of introducing an *Univerſal Character*, by which all nations ſhould expreſs their common conceptions, it may be allowed that three or more perſons, may, by conſent, agree on ſuch characters, whereby to expreſs their thoughts in writing, without regarding the ſound of words; and if this may be done by new invented characters, why not as well by thoſe already in uſe? Which, tho' they ſignify ſounds by common uſe, yet they may be applied to ſignify *immediately* things or notions; and conſequently, while it is purely arbitrary, by what character any thing or notion is expreſſed, we may as well uſe that collection of letters, to expreſs things to the eyes of the deaf, by which others expreſs the ſound or name of it to thoſe that hear; ſo that, indeed, that will be to him a real character, which expreſſes to another a vocal ſound, and ſignifies to both the ſame notion.

The perſon, Dr. *Wallis* undertook to teach, was Mr. *Daniel Whaley* of *Northampton*, who was very ingenious, and ſo far, at leaſt a mathematician, as to draw pictures, whereby he was already accuſtomed to obſerve and imitate thoſe little niceties in a face, without which, it is not poſſible to draw a picture well: Once he could have ſpoken, tho' ſo long ago, that he ſcarce remembered it; but having about five years of age, loſt his hearing, he by conſequence loſt his ſpeech alſo, not at once, but gradually in about half a year's time, ſo that his dumbneſs did not originally proceed from any indiſpoſition in the organs of ſpeech, but was a conſequence of his want of hearing: And tho' it was

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poſſible to teach him ſo to ſpeak as to be underſtood, yet not with that accuracy, that a critical ear might not eaſily diſcern ſome failures or little differences from the ordinary tone; beſides, the ear being ſo neceſſary to guide the tongue, it is not reaſonably to be expected, that he who cannot hear, tho' he may know how to ſpeak truly, ſhould yet perform it ſo accurately, as if he had all the advantage of his ear: Nor could it be expected, that he ſhould be able to make ſo great uſe of ſpeaking as others do, as he cannot hear what others ſay to him, nor expreſs his own thoughts to them; and tho' he might in time diſcern, by the motion of the lips, what is ſaid to him, yet this cannot be expected, till he is ſo far maſter of the language, as that by a few letters known, he may be able to ſupply the reſt of the word, and by a few words, the reſt of the ſentence, or at leaſt the ſenſe of it by a probable conjecture, as is the caſe in deciphering letters; and yet the eye cannot actually diſcern all the varieties of motion in the organs of ſpeech, many of them being internal: As to the other part of the deſign, *viz.* the underſtanding of a language, there ſeems to be no reaſon at all to doubt, but he might attain this as perfectly as thoſe that hear, and write it as well.

The method to be uſed in the teaching a dumb perſon to ſpeak, is as follows; you muſt firſt, by the moſt ſignificant ſigns you can deviſe, make him underſtand the poſture and motion of the tongue, lips, and other organs of ſpeech, in forming any ſound; which, if he hit right, you are to confirm him in it, and if he miſs, to ſignify to him in what he differed from your direction, and to what circumſtances he muſt attend to correct it; and it would be in vain to enter upon this taſk without exactly conſidering, and being perfectly maſter of the accurate formation of every ſound in ſpeaking: As to the method of teaching the language, begin with ſuch actions and geſtures, as have a natural ſignificancy; and from them, or ſome few ſigns the perſon himſelf had before taken up to expreſs his thoughts, proceed to teach him the meaning of ſomething elſe, and ſo by degrees to other things; and this in ſuch a method, that what he knows already may be a ſtep to what he is next to learn.

This gentleman, Mr. *Whaley*, at a meeting of the Royal Society, *May* 1662, pronounced diſtinctly ſuch words as were propoſed to him, tho' not with the uſual tone or accent, yet ſo as eaſily to be underſtood; he did the like ſeveral times at *White-Hall*, in the preſence of his majeſty, his highneſs prince *Rupert*,

Rupert, and many others of the nobility: In the ſpace of a year, which was the whole time of his ſtay with Dr. *Wallis*, he had read over a great part of the *Engliſh* Bible, and had attained ſo much ſkill, as to expreſs himſelf intelligibly on ordinary affairs, to underſtand letters written to him, and to write anſwers to them; and in the preſence of many foreigners, he not only read *Engliſh* and *Latin*, but pronounced the moſt difficult words of their language, and even *Poliſh* itſelf. Dr. *Wallis* made the like experiment on Mr. *Alexander Popham*, who was deaf from his birth.

The Sal-Gemmæ Mines *in* Poland. Phil. Tranſ. N° 61. p. 1099.

THESE mines are a mile diſtant from *Cracow*, near the ſmall town *Wiliska*, which, except the church, is all dug hollow under ground; there are four ſquare deſcents into them, four or five foot long and as many broad, lined with timber, the two principal being in the town itſelf, are thoſe thro' which the ſalt is drawn up; the other two ſerve for letting down timber and other neceſſaries: Above ground is a great wheel, turned round by a horſe, with a ſtrong rope as thick as a man's arm; to the big rope, is tied another, which one faſtens in ſuch a manner about his middle, as to ſit in it, and take another perſon in his lap, and hold him faſt; whereupon the big rope being let ſomewhat down, another faſtens a piece of rope to the other thick rope, and ſeats himſelf in it, taking another man in his lap, and he being let down a little way, gives place to others to do the like; in which manner, 30, 40 or more may be let down all at once; and thus they deſcend to the depth of 100 fathoms, and then they come to ladders, by which they deſcend 100 fathoms more; the ſeveral paſſages and holes are ſupported with ſtrong timber.

Out of theſe mines are dug three ſorts of ſalt; the firſt, a common, coarſe and black ſalt; the ſecond, a little finer and whiter; the third, very white and clear like cryſtal; the coarſe and black ſalt is cut out into large roundiſh pieces, three *Poliſh* ells long, and one thick, which coſts from 50 to 70 *Poliſh* florins: The inhabitants of *Cracow* have the privilege of a certain number of pieces, at eight florins the piece. The great pieces lie before their doors, and are licked by the cattle, afterwards they are ground for uſe in mills and other engines; their colour is a darkiſh grey, with ſome mixture of yellow: When this ſalt-work was firſt found, the miners were *Germans*, whence the poles have retained the *German* names of the tools and

and given them *Poliſh* terminations: Theſe mines belong to the king of *Poland*, and are one of the beſt branches of his revenue, and there are 1000 men employed in them: They keep three horſes always below, for carrying the ſalt from the places where it is dug, to where it is drawn up by the abovementioned wheel and ropes, turned round by a horſe above ground: The horſes, after being a while under ground, grow blind from the ſharpneſs of the ſalt, and their hoofs grow as long again as they do uſually, near a ſpan long: Beneath are certain ſalt-ſprings, whence the ſalt-water is conveyed by channels to ſeveral places where it is boiled to ſalt.

In the deſart of *Podolia*, near the *Boriſthenes*, is a ſalt-lake, whoſe water is evaporated by the ſun's heat, and turned to ſalt, like ice.

The Way of making Vinegar *in* France. Phil. Tranſ. N° 61, p. 2002.

THEY take two large caſks, at the bottom of each they put a trevet of a foot high, and as large as the caſk will allow of: On this trevet they put vine-twigs, on which a ſubſtance called rape is laid, with which they fill both veſſels within half a foot of the top; and this rape is no other than the wood or ſtalks of the cluſters of grapes dried and freed from the grapes; and the trevet and vine-branches are put at the bottom of the caſks, to keep the rape from ſettling; for it is this rape which alone heats and ſours the wine; the two veſſels being almoſt quite filled with the rape, one of them is filled up with wine, and the other only half full for that time; and half the wine in the full veſſel is drawn off every day to fill up the other, and thus they fill and empty the veſſels by turns; generally, in two or three days, the half filled veſſel begins to heat, and this heat encreaſes for ſeveral ſucceeding days, till the vinegar is perfectly made, which the workmen know by the ceaſing of the heat: In ſummer it is the work of 15 days; in winter it proceeds more ſlowly, and in proportion to the degree of cold: When the weather is hotteſt, the wine muſt be drawn twice a-day from one veſſel to the other; it is only the half filled caſk that heats, and as ſoon as you have done filling, its heat ceaſes for that time, and the other caſk begins to heat: The full veſſel is quite open a-top; but that half full has a wooden cover: The beſt wine makes the beſt vinegar; and yet good vinegar is made of wine that is turned: The wine, in changing, leaves a certain greaſe, which

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ſticks partly to the ſides of the caſk, and partly to the rape, ſo that if the rape is not cleanſed once every year, the wine turns to a whitiſh liquor, which is neither wine nor vinegar: At the time of pouring the wine out of one veſſel into the other, there ariſes a ſcum on the top, which muſt be carefully taken off: In caſks, that were never uſed for this purpoſe, vinegar is made more ſlowly, than in thoſe already uſed.

The rape as ſoon as it is ſeparated from the grapes, which is done immediately after the vintage, is carefully put up in barrels, leſt it take air, without which it would heat and be ſpoiled: There is no other way of preſerving rape that has once been uſed, than drowning of it, that is, filling the veſſel wherein 'tis contain'd with wine or vinegar: Rape will ſerve a year, providing care be taken of cleaning every morning with a piece of linnen, the greaſe on the ſides of the veſſel, and with a little broom, that which ſwims on the top of the liquor; it may be freed of its greaſe with water, by rubbing it between the hands; the nature of this greaſe is not hitherto known: Some are ſaid to make vinegar with phlegm of wine after diſtillation.

Pneumatical Experiments; *by* Mr. Boyle. Phil. Tranſ. N° 62 p. 2011.

UPON putting a duck into the receiver of an air pump, and exhauſting the air, in the ſhort ſpace of a minute ſhe appeared much diſcompoſed, and between that and the ſecond minute, her ſtruggling and convulſions increaſed ſo much, that ſhe ſeemed to be expiring; ſo that notwithſtanding nature has enabled water-fowl to continue for ſome time without reſpiration under water, yet they are not able to hold out conſiderably longer than a hen or other land-fowl: This duck being revived by the admiſſion of freſh air, and again ſhut up in the ſame receiver with the air in it, continued five times as long as before, without being diſordered: Upon putting a duckling into the ſame receiver, before the end of the firſt minute, ſhe gave manifeſt ſigns of being much diſordered, and in two minutes, her convulſions obliged us to let in the air, whereby ſhe quickly recovered: When the receiver was pretty well exhauſted, ſhe appeared manifeſtly bigger, than before the air was withdrawn, eſpecially about the crop, tho' that was very turgid before; the ſame duckling was ſhut up very cloſe in the ſame receiver for ſix minutes without growing ſick by her impriſonment.

Including a viper in a ſmall receiver, as the air was exhauſted, ſhe began to ſwell, and afforded theſe phænomena. 1. It was a good

good while after ceaſing to pump, e'er the viper began to ſwell ſo much, as to be made to gape. 2. She continued above two ½ hours in the exhauſted receiver and gave ſigns of life. 3. After ſhe was once ſo ſwelled, as to be obliged to open her jaws, ſhe appeared ſlender and lank again; and yet very ſoon after appeared to ſwell again and open her jaws wide as before. Including a viper in the leſſer ſort of receivers, and exhauſting the air, the viper moved up and down, as if it were to ſeek for air, and after a while foamed a little at the mouth; the body did not ſwell conſiderably, and her neck leſs, till a good while after the exhauſtion; but afterwards her body and neck grew prodigiouſly tumid, and a tumor appeared on her back: An hour and a half after exhauſting the receiver, the diſtended viper gave manifeſt ſigns of life, but none afterwards; the tumor reached to the neck, but did not ſeem to affect much the under jaw; both the neck and a great part of the throat held between the eye and the candle, were tranſparent enough, where the ſcales did not interpoſe: The jaws remained wide open, and a little diſtorted; the *Epiglottis* with the *Rimula laryngis* or *Glottis*, which remained gaping, was protruded almoſt to the farther end of the lower jaw: Upon re-admitting the air at the end of 23 hours, the viper's mouth was preſently cloſed, tho' ſoon after it opened again, and continued ſo for a long time; and on ſcorching or pinching the tail, ſhe gave ſome ſigns of life. Including an ordinary common ſnake, together with a gage, into a portable receiver, which being exhauſted of air, was laid aſide in a place, where it continued from 10 or 11 in the forenoon, till about nine next morning, tho' he ſeemed to be dead, and gave no ſigns of life upon ſhaking the receiver, yet on holding the glaſs at a convenient diſtance from a moderate fire, in a little time he gave ſigns of life, and even exerted his forky tongue; and in this condition he was left till next day in the afternoon, when he was found paſt recovery, and his jaws, which were formerly ſhut, gaping exceeding wide, as if ſtretched open by ſome external force.

Including a large frog in an exhauſted receiver, ſhe continued alive about two hours, ſometimes moving from one ſide of the receiver to the other; the animal ſwelled, and did not appear by any motion of her throat or thorax to breathe; her head was not much ſwelled, nor her mouth forced open: After remaining there above three hours, and perceiving no ſigns of life in her, the air was admitted, and her tumid body was ſhrunk very much, and being taken out of the receiver, ſhe appeared quite dead,

 but

but laid on the graſs in a garden all night, the next morning ſhe was found alive: Putting a frog into a ſmall receiver, about 11 in the forenoon, and exhauſting the air, and turning the cock under water, it took in about 13 $\frac{1}{4}$ ounces of water, and the frog continued in the receiver, all the while under water, lively enough till about 5 in the afternoon when it dy'd: The frog ſeemed not at firſt to be much altered by the exhauſtion of the air, but continued breathing both with her throat and lungs.

Including in a pretty large receiver a couple of frogs newly taken, one of them not above an inch long, the other very large; whilſt the air was exhauſting, the leſſer frog ſkipped up and down in a very lively manner, and clambered up ſeveral times the ſides of the receiver; but in a quarter of an hour he lay dead, with his belly upwards; the large one held out half an hour, tho' he began to ſwell much on the withdrawing the air, and to leap up and down in the receiver, as it was exhauſting: Shutting a little frog into a ſmall portable receiver, on the firſt pumping, ſhe was lively enough, but when the air began to be conſiderably withdrawn, ſhe appeared to be much diſordered, and after the receiver was taken off, the frog was alive and continued to appear ſo near an hour, tho' the abdomen was very much, and the throat ſomewhat diſtended; at the end of 3 $\frac{1}{4}$ hours after the removal of the receiver from the pump, the air was admitted, upon which, the abdomen, which then was ſtrangely ſwelled, did not only ſubſide but ſeemed to have a great cavity in it, as alſo the throat proportionably, which contiuued after the frog was dead: Upon conveying a large frog into a proper receiver, and exhauſting the air, her body was gradually diſtended; the receiver with the gage was kept under water near 7 hours, at the end of which, the receiver was found tight, but the frog dead and exceedingly ſwelled, upon admitting the air, ſhe became more hollow and lank than ever.

In order to try, whether animals, that had lately been accuſtomed to live, either without any, or without a full reſpiration, would not be more ſlowly killed by the want of air, than others, which had been longer uſed to a free reſpiration; a kitten, that had been kittened the preceeding day, was put into a ſmall receiver, in a minute or a little more, after the air began to be firſt exhauſted, the little animal, that in the mean time was gaſping and had ſome violent convulſions lay as dead; but on admitting the air, it immediately gave ſigns of life, and being taken out of the receiver, quickly recovered: Another of the ſame litter being put into the ſame receiver, it ſoon began to have

have convulſions, after which it lay as dead; and tho' the pumping was continued, and the engine ſeemed not to leak, yet the kitten began to ſtir again, and after a while had ſtronger and more general convulſions than before, till, at the end of full ſix minutes after the firſt exhauſtion of the air, the animal ſeemed quite dead, and taken out of the veſſel, it lay with its mouth open, and its tongue lolling out without any ſenſible breathing and pulſation, but pinching him made him give immediately ſome ſigns of life, tho' there was ſtill no ſenſible motion of the heart or lungs; but afterwards gaping and fetching his breath in an odd manner, and with much ſtraining, as fœtus's are ſeen to do, when cut out of the womb, in about a quarter of an hour he recovered gradually: Incloſing a third of the ſame litter in the ſame receiver, it was obſerved, that ſeveral violent convulſions, at the ſecond or third exhauſtion, ended in a ſeeming death, in about a minute and a half: A while after, tho' the pumping was continued, the kitten gave manifeſt ſigns of life, after ſeveral convulſions, as great as thoſe of the firſt fit; in ſeven minutes after working the pump, the air was let in, but tho' it was taken out of the receiver, and *Aqua Vitæ* poured into its mouth, yet it died. By theſe experiments it appears, that theſe animals continued thrice longer in the exhauſted receiver, than other animals of that bigneſs would probably have done.

Putting ſome water into an open tube, and ſuffering the air to eſcape in an exhauſted receiver, the water did not ſeem to loſe its bulk in any ſenſible degree. Filling a tube, ſealed at one end with water, and 36 inches long, and inverting it into a glaſs veſſel, leſs than 2 inches in diameter, and but little more than $\frac{1}{4}$ inch in depth; conveying theſe glaſſes into a fit receiver, and the air being leiſurely exhauſted, and gently re-admitted, the many bubbles that had aſcended, during the operation, formed a-top an aerial aggregate, amounting to $\frac{8}{10}$ of an inch. Preſently after, another tube was filled with the ſame water, and inverted, and the water being let fall to the ſurface of that in the veſſel, and the air let in again, the water was driven up to within $\frac{1}{10}$ of an inch of the very top: The tube for meaſuring air concealed in water, was 43 $\frac{1}{2}$ inches above the ſurface of the ſtagnant water; the air collected out of the bubbles at the top of the water was the firſt time better than $\frac{3}{4}$ of an inch, and the water in the pipe ſubſided as low as the ſurface of the ſtagnant water; the ſecond time, only $\frac{1}{8}$ and $\frac{1}{16}$, and it ſubſided to 4 or 5 inches above the ſurface of the water in the open veſſel: It muſt be obſerved, that the air at the top of the tube did poſſeſs more room than its bulk did ab-

ſolutely require; becauſe it was ſomewhat defended from the preſſure of the atmoſphere by the weight of the ſubjacent cylinder of water, which might be about 3 or 4 foot long: Having provided a clear round glaſs 3 ½ inches in diameter, with a ſtem 9 inches long, which was melted within an inch of the top, at the flame of a lamp, and drawn out for two or three inches as ſlender as a crow's quill, that the decrement of the water, on the receſs of the air lodged in its pores, might the more eaſily be obſerved and eſtimated; above this ſlender part of the pipe, the glaſs was of the ſame largeneſs, with the reſt of the ſtem, that the aerial bubbles aſcending thro' the ſlender part, might there find room to break, and ſo prevent the overflowing, or loſs of any part of the water; after filling this veſſel, not without ſome difficulty, till the liquor reached the top of the ſlender part, where not being uniformly enough drawn out, it was ſomewhat broader than elſewhere, it was conveyed together with a pedeſtal, whereon to reſt, into a high receiver, and exhauſting the air, numerous bubbles diſcovered themſelves aſcending nimbly to the upper part of the glaſs, where they made a kind of froth or foam: This done, the pump was ſuffered to reſt a while, to give the aerial particles, lodged in the water, time to diſentangle themſelves and emerge, which when they had done a pretty while, the pump was plied again, to prevent any air's getting in to ſo large a receiver: This alternate pumping and reſting laſted for a conſiderable time, till at length, the bubbles began to be very rare; after which, the external air was let into the receiver, and tho' a great number of bubbles had eſcaped out of the water, the difference of the water's height did not amount to above, if ſo much, as a hair's breadth; and the chief operator in the experiment profeſſed, that for his part, he could not perceive any difference at all.

Filling a glaſs of the ſame ſhape, and much of the ſame bigneſs, with red wine, and placing it on a convenient pedeſtal in a high receiver, ſome of the air was exhauſted; and in a little time, there emerged thro' the ſlender pipe, ſuch a number of bubbles darted as it were upwards, as was both agreeable and ſurpriſing to the ſpectators, and they aſcended very ſwiftly for upwards of a quarter of an hour.

Upon putting an oyſter into a very ſmall receiver, and keeping it there long enough to have ſucceſſively killed three or four birds or beaſts, *&c.* it was not killed, nor, for ought could be perceived, conſiderably diſordered, only at each ſuction, the air, contained between the two ſhells eſcaped at their joining, as was concluded from the foam: About 24 hours after, this and

another

another oyster, that had been put at the same time into the receiver, were alive: Putting a craw-fish into a pretty large receiver, it did not seem to be much disordered, till the air was in great measure pumped out, and then its former motion presently ceased, and it lay as dead; upon admitting a little air into the receiver, it began presently to move a-fresh, and on withdrawing the air again, it became motionless; having repeated this two or three times, it was taken out of the receiver, without having sustained any harm: Putting an oyster into a vial full of water included in a receiver, that the motion of the bubbles might be seen thro' the water; this oyster was so strong, as to keep itself close shut, and repress the eruption of the bubbles all the time of the experiment: Upon substituting a more vigorous craw-fish in the room of the former, in spight of all the pumping, it continued moving in the receiver.

Into a receiver, shaped almost like a bolt-head, containing near a pint by estimation, and its globular part almost filled with water, was put at the orifice, which was pretty large, a small gudgeon, about three inches long; after exhausting very well the air, to 19 or 20 parts of contained air; it was observed, 1. That tho' there appeared a great number of bubbles about the fish; yet the rest of the water, notwithstanding the withdrawing of so much air, emitted no froth, and but few bubbles. 2. The fish discharged both at his mouth and gills, for a long time, a great number of bubbles; and whenever he lay still, new bubbles would adhere to many parts of his body, especially, his fins and tail, as if they were generated there; so that he would appear all beset with bubbles, and if he was obliged to move or swim, he would quickly shake them off, and as soon recover them again, upon a little rest. 3. He gaped and moved his gills all the while, as before he was included; tho' towards the end, it often happened, that he neither took in, nor emitted any aerial particles that could be perceived. 4. After a while, he lay almost constantly with his belly upwards, and yet in that posture swam briskly. 5. He seemed, after a while, to be more lively, than when first put in: About an hour and a half after being inclosed, he was almost free from bubbles, with his belly upwards, and seeming somewhat tumid, but lively as before: But in about an hour after, he seemed to be motionless and somewhat still; upon opening the receiver under water, which rushed in, till it had filled the empty part of the ball, and the greatest part of the stem, the fish sunk to the bottom with all the signs of life imaginable, and conveying him thro' the pipe into a bason of water, he lay for some

ſome hours on one ſide or the other, without being able to ſwim or lie on his belly, which appeared very much ſhrunk: All the while he continued in the baſon of water, tho' he moved his gills, as before he had been incloſed, yet he emitted in this new water no bubbles, and at length he was able to lie conſtantly on his belly: He lived in the baſon eight or ten days, tho' ſeveral other gudgeons died in much leſs time.

A ſmall bird, with the abdomen opened almoſt from ſide to ſide without hurting the guts, was put into a ſmall receiver, and the pump being wrought, continued for ſome time without giving any ſigns of diſorder; but about a minute and a half from the beginning of the exhauſtion, it began to have convulſive motions in the wings, and at the end of two minutes it was found dead; and yet no remarkable alteration was obſerved in the lungs; and the heart, or at leaſt its auricles, were found beating, and continued ſo for a while after: Upon making two inciſions on the abdomen of a large frog, in ſuch a manner that the two lobes of the lungs came out thereof, and ſuſpending the frog by the legs in a ſmall receiver, and exhauſting a good deal of air, the animal ſtruggled very much, and ſeemed to be much diſordered; and after the receiver was well exhauſted, it lay ſtill for a while as if dead, with the abdomen and thigh very much ſwelled, as if forcibly diſtended by ſome rarified vapour or air; but as upon putting in the frog, one of the lobes was almoſt full, and the other almoſt ſhrunk up; ſo they continued, after the receiver had been exhauſted; but upon the admiſſion of the air, the body ceaſed to be tumid, and the ſwelled lobe appeared ſhrunk up like the other, and the receiver being removed, the frog preſently revived, and quickly began to fill the lobe again with air.

The heart of an eel being taken out, and laid on a plate of tin in a ſmall receiver, it was perceived to beat there as in the open air, and exhauſting the veſſel, the heart grew very tumid, and here and there emitted little bubbles, yet it continued to beat as manifeſtly as before, and ſeemed to be more quick: The heart of another eel, after being included in a receiver, firſt exhauſted, and then ſecured from leaking, appeared tumid, and continued to beat there near an hour; after which, finding its motion very languid, by breathing a little on that part of the glaſs where the heart lay, it ſoon recovered its motion; and thus it could always be renewed by the application of a little warmth; after three hours, a bubble between the heart and the auricle, ſeemed to have now and then a little tremulous motion, but it was ſo faint, that no warmth could quicken it, nor the admiſſion of the external air.

In

In order to compare the times, in which animals die by withdrawing the ambient air, and by being ſuffocated in water, a green-finch, with his legs and wings tied to a weight, was gently let down into a glaſs body filled with water; and in half a minute, it was found quite dead; a ſparrow was tied to the ſame weight, and let down after the ſame manner; but tho' it ſeemed to be more vigorous under water than the other bird, yet in half a minute it died: Holding a mouſe by the tail under water, it emitted ſeveral bubbles of air from its mouth, and as a ſpectator affirmed, from one of his eyes; being taken out in ſomething more than half a minute, he retained ſome motions, which proved to be convulſive; and at laſt died: Upon tying a conſiderable weight of lead to the body of a duck, and putting her into a tub full of clear water, where ſhe continued for a minute quietly enough, but afterwards ſhe appeared much diſordered; in two minutes ſhe was taken out, and found alive; immerging her a ſecond time into other freſh water, ſhe emitted ſeveral bubbles at her beak and noſtrils, and continuing above two minutes in the water, ſhe began to ſtruggle very much; after four minutes, the bubbles were fewer, and then ſhe began to gape, without emitting any bubbles; and thus ſhe continued gaping for ſix minutes, when all her motions appeared to ceaſe, and her head to hang down, and after ſeven minutes ſhe was found quite dead; ſo that this water-fowl could not live in cold water, without taking in freſh air, above ſix minutes: A weight was tied to a duckling's legs, and being let down into a tub of water, the greateſt part of the time of her being immerſed, ſhe emitted many bubbles at her noſtrils, and ſtill more from a certain part about her head, equally diſtant from her eyes, and nearer the neck; after much ſtruggling and frequent gaping, ſhe had ſeveral convulſions, and drooped her head, and thus in three minutes ſhe became motionleſs, and at the end of four minutes ſhe was found dead: A viper that was kept ſo many hours in an exhauſted receiver, till it was concluded to be quite dead, was kept all night in a glaſs-body on a warm digeſtive furnace, and it was found next morning very lively; ſinking her with a weight into water in a tall glaſs receiver, with a cork fitted to its orifice, in an hour and a quarter ſhe often exerted her black tongue, and in four hours ſhe appeared to be alive, ſwimming all this while in the water; after ſeven hours ſhe appeared quite dead. Though ſome of the above mentioned animals ſeem to have been a little ſooner deſtroyed by drowning, than by the air-pump, yet

that

that is no certain proof, that ſuffocation kills ſooner than the want of air; for in drowning, that which deſtroys, is at the very firſt, and all at once, applyed in its full vigour; whereas receivers cannot at once be deprived of their air, but by degrees; ſo that to the very laſt, the receiver will not be entirely exhauſted; for having expreſly provided a very ſmall receiver, that could be exhauſted at one ſuction, a mouſe was killed in it in leſs than half a minute.

A Continuation of the Pneumatical Experiments; *by Mr.* Boyle. Phil. Tranſ. N° 63. p. 2035.

UPON putting a linnet into a receiver, the glaſs was well cloſed with cement and a cover, and no air was exhauſted, nor any new air admitted, yet it continued there for three hours; and tho' it ſeemed a little ſick, yet being afterwards taken out, it recovered and lived ſeveral hours; from the ſame receiver having exhauſted half the air, and putting a linnet into it, and the air, as appeared by a gage, continuing in the ſame ſtate, it lived an hour and a quarter before it ſeemed to be in any danger, and on admitting the air it recovered, and being taken out into the open air, flew away: Including in a receiver a lark, with a gage, by which it appeared that $\frac{3}{4}$ of the air was exhauſted, the bird was then obſerved to pant much, and a little after, it fell into convulſions, and before the air could be admitted, it died: Preſently after, putting into the ſame receiver a green-finch, and exhauſting half the air, as appeared by the gage; in a minute after, the bird was obſerved to be very ſick, and after the evacuation of a certain ſubſtance by the mouth, it ſeemed to recover, and continue pretty well, yet ſtill panting; and at the end of four minutes, growing very ſick, ſhe vomited again, and recovered very much; at the end of a full quarter of an hour from the firſt exhauſting the receiver, the bird appeared to live: A viper was included, together with a gage, in a portable receiver, and exhauſting the veſſel, ſecuring it againſt the regreſs of the air, the impriſoned animal was obſerved not only to be alive, but nimbly to exert its tongue, about 36 hours, after it was firſt ſhut up; after 60 hours it appeared very dull and faint, and not likely to live much longer; next day, it was found ſtone dead, with its mouth wide open, and the air was found exhauſted to four parts in five.

Travellers obſerve, that on high mountains, they are obliged to fetch their breath oftner than uſual; and it may be worth inquiry,

inquiry, whether this be owing to the thinneſs of the air, or to ſome ſteams in it, ſuch as ſulphureous exhalations.

Including a mouſe in a fine limber and clear bladder, and putting both into a receiver, the air was gradually exhauſted, and that in the bladder proportionably expanded itſelf, and ſo diſtended the bladder, that by the rarefaction, the air was become unfit for reſpiration, and the animal ſeemed to be in danger; whereupon admitting the air into the receiver, it compreſſed the ſwelled bladder to its former dimenſions, and conſequently the included air was reduced to its former denſity, by which means the fainting mouſe was quickly revived.

Taking a number of tadpoles, and putting them in water into a portable receiver, at the firſt exhauſtion of the air, they roſe to the top of the water, tho' moſt of them ſubſided again, till they were raiſed by the next exhauſtion; they ſeemed by their wriggling motion to be very much diſcompoſed; the receiver being exhauſted, they continued moving on the ſurface of the water, and ſome of them endeavouring to dive to the bottom, were ſoon buoyed up again; in a little more than an hour, they were all motionleſs, and lay floating on the water; and on opening the receiver, and admitting the air, they preſently ſunk to the bottom, but none of them recovered.

Upon including four or five of thoſe odd aquatic inſects, of which gnats are generated, with ſome of their water, in a ſmall glaſs receiver, which being exactly cloſed, was kept in a ſouth window, where thoſe little animals continued to ſwim up and down for ſome days, after which, they put off their *Exuviæ*, or caſt-ſkins, and became perfect gnats; and they lived a good while in this thin medium, till hunger or cold deſtroyed them.

Putting the warm blood of a lamb or ſheep in a wide-mouth'd glaſs into a receiver, it was a great while after exhauſting the air, that the more ſubtile parts of the blood began to force their way thro' the more clammy and viſcid parts, and ſeemed to boil in large cluſters, ſome as big as large beans or nutmegs; and ſometimes, the blood was ſo volatile, and the expanſion ſo great, that it boiled over the containing glaſs, tho' it did not fill, at firſt putting in, a quarter of it: Including ſome warm milk from the cow in a cylindrical veſſel, four or five inches high, when the external air was fully withdrawn, the milk began to boil, and that for a good while, and ſo impetuouſly, that it ran over the containing glaſs, tho' there were not above two or three ounces of liquor in it; and gall was obſerved to be much more diſpoſed to ſwell, which is agreeable

to the viſcidity of its texture: The deſign of making the preceeding experiments was to determine, whether the little bubbles, appearing on the removal of the external air, do ſo diſtend the veſſels of animals, eſpecially the ſmaller, as to cauſe obſtructions, and ſo ſtop the circulation of the blood; and what ſeems to confirm that it does, is that a bubble was once obſerved in the aqueous humour of one of the eyes of a viper, included in an exhauſted receiver; and that particles of air are contained, not only in the blood and other juices, but alſo in the ſofter parts of the body, it was obſerved that upon putting the liver and heart of an eel, after cutting them a-croſs, into a receiver, and exhauſting the air, the liver was manifeſtly ſwelled, and at the place of inciſion ſeveral bubbles eſcaped, and on the admiſſion of the external air, both theſe parts preſently ſhrunk.

A young mouſe was included in a round vial with a wide neck, on whoſe upper part a fine thin bladder was ſtrongly tied, out of which the air had been carefully expreſſed, and putting it into a receiver, with a mercurial gage; the air was gradually pumped out to a fourth part, as appeared by the gage, and the air, expanding itſelf in the phial, ſeemed to have blown the bladder half full, and the mouſe was very much diſordered; but upon re-admitting the air into the receiver, the animal recovered; a little after, the experiment was repeated, and the air was by the gage reduced to its former degree of rarefaction, and the mouſe was kept in that thin air four minutes, after which it appeared to be ſick, and was recovered again with difficulty: Conveying him again, after ſome reſpite, into a receiver, and reducing the air to its former degree of expanſion, he was kept there for a full quarter of an hour, without any diſorder; and in ſome time again, after recollecting his ſtrength, he was re-conveyed into the receiver, and pumping out the air, till the mercury in the gage was half an inch lower than in the former experiments, the animal was not diſcompoſed for a full quarter of an hour, and three exhauſtions more were made, before he ſeemed to be affected; afterwards, the air being admitted into the receiver, the mouſe was ſpeedily revived. And theſe experiments of accuſtoming animals to the pump ſeemed the more conſiderable, becauſe the air, in which the mouſe lived all this time, had been infected with the excrementitious effluvia of its body.

Having conveyed a mouſe of an ordinary ſize into an oval glaſs, fitted with a long and broad neck, in which was a

mercu-

mercurial gage, the upper part of the neck was hermetically ſealed; and tho', on account of the largeneſs of the veſſel in reſpect of ſo ſmall an animal, he ſeemed to be rather drooping than dying at the end of the ſecond hour; yet in half an hour more, he was thought to be quite dead, and there was no change in the height of the mercury, but breaking off the ſealed part of the glaſs, and blowing in freſh air with a pair of bellows, the gaſping animal revived, tho' but ſlowly: Such another experiment was made with the like ſucceſs on a ſmall bird, included with a gage in a receiver; the bird in about half an hour appeared to be ſick and drooping, and the faintneſs and difficulty of breathing encreaſed for about two hours and a half more, when the animal died, tho' the gage was not ſenſibly altered: Having hermetically ſealed up a ſmall bird in a glaſs phial, in a few minutes it began to be ſick and to pant, and in that condition it continued half an hour; and then having provided a veſſel of water with ſal-armoniac newly put into it, the phial with the ſick bird was immerſed into the water, and held there for ſix minutes, without ſenſibly reviving the drooping animal, who continued to pant exceedingly as before; ſo that this remedy proving ineffectual, the phial was removed out of the water, and the bird ſome time after, as was foretold, ſtrained to vomit, which was followed by evacuations downwards, before ſhe quite expired, which happened within a minute or two of a full hour, after her firſt impriſonment.

To ſhew the uſe of air in reſpiration, there was made by diſtillation a blood-red liquor, conſiſting chiefly of ſuch ſaline and ſpirituous particles, as may be obtained from the maſs of blood in human bodies; this liquor is of ſuch a nature, that if a glaſs phial, half filled with it, be kept well ſtopped, it will emit from it no ſmoke or viſible exhalation; but if the phial be unſtopped, in a quarter of a minute or leſs, a copious white ſmoke will ariſe, not only filling the upper part of the glaſs, but plentifully diſcharging itſelf into the open air: This experiment may ſerve to illuſtrate the office of the air, which is to carry off in exſpiration the fuliginous ſteams of the lungs; for in this experiment, it is plain that the mere contact of the air, may give the corpuſcles of moiſt bodies a peculiar volatility, or facility to emerge in the form of ſteams; and here two things are to be obſerved, one is, that when the phial has lain ſtopped a ſufficient time, the upper half of it will appear deſtitute of fumes, whereof the air, it ſeems, only imbibes and retains a certain moderate quantity; which may in ſome meaſure

account for air not being for any long time fit for refpiration, that is entirely clogged with fteams, that action requiring frequent fupplies of frefh air; and alfo account for the unftopped phial, not emitting any vifible fteams in *Vacuo*; whereas, when the air is by degrees admitted, the fumes are prefently raifed.

Having included two white fnails without fhells, of different fizes, one an inch and a half, the other, an inch in length, into a fmall portable receiver, carefully exhaufted, and fecured againft the return of the air; it was obferved, that both the fnails alternately exerted and retracted their horns, and that they emitted from their bodies at the fame time a great many bubbles; after fome hours, tho' not fo foon as fome animals, they appeared motionlefs, and much fwelled; the inward parts of their bodies were entirely vanifhed, and they feemed a couple of full blown bladders; and on the admiffion of the air, they immediately fhrunk, as if the bladders had been prick'd, and fuffered the air to efcape, but neither of them, after that, gave any figns of life.

Upon putting into a receiver an eft, and exhaufting the air, he continued alive in it for 48 hours, but his belly appeared a little fwelled; his under jaw moved the firft night, but not the day and night following; upon opening the receiver under water, it was obferved, that about half the air had been exhaufted; as foon as the water was impelled into the glafs, the animal that was before dull and liftlefs, feemed to be ftrangely revived.

Having fhut up a leech together with fome water in a portable receiver, the air was exhaufted, and the receiver being removed to a lightfome place, the animal, as was expected, held under water, and there emerged from feveral parts of its body a great many bubbles; yet the leech did not feem to be much difcompofed all this time, and continued lively after five days, tho' the receiver continued well exhaufted.

Five or fix caterpillars were put into a receiver, in about an hour after exhaufting the air, they were obferved to move; but in about ten hours after their firft inclufion, they feemed to be quite dead; yet upon reftoring the air, next day, three or four of them revived: Putting a large cobweb of caterpillars, after dividing it in two parts into equal receivers; and including in one of them the caterpillars, together with the air, and exhaufting the air out of the other; the event was, that in that which had the air, the little animals appeared to move, whereas in the exhaufted glafs, there was no motion perceivable.

Four

Four middle-ſized fleſh flies, with their heads cut off, were incloſed in a portable receiver, furniſhed with a pretty large pipe and a bubble at the end; as ſoon as the receiver was exhauſted, the flies loſt their motion; in an hour or two after, letting in the air in a little time they began to move their legs, and one or two of them began to walk: Several ordinary flies, and a bee or waſp were incloſed, all which, after the air was fully exhauſted, lay as dead, only for a few minutes, ſome of them had convulſive motions in their legs; in this ſtate they continued 48 hours, after which the air was let in, but none of them recovered: Having put a great fleſh-fly into a ſmall portable receiver, which, as ſoon as the air was exhauſted, fell on its back, and ſeemed to have convulſions in its feet and *proboſcis* or trunk, but recovered preſently, on the admiſſion of the air, which being again exhauſted, it lay as dead; in a quarter of an hour more, upon ſhaking the receiver, it moved but faintly; next night by warmth and letting in the air, the fly recovered; but the following morning being ſealed up again in that glaſs, and kept 48 hours, tho' over the chimney, the animal was found quite dead: A large graſshopper, whoſe body, beſides the horns and limbs, was an inch long, and proportionably thick, was conveyed into a portable receiver of an oval form; when the air began to be conſiderably rarefied, he appeared to be very uneaſy, and ſeemed to ſweat out of the abdomen many little drops of liquor, which uniting, trickled down the glaſs, like a little ſtream, amounting to near a quarter of a ſpoonful; and by the time the receiver was ready to be taken off, the graſshopper fell on his back, and lay as dead, and continued ſo for three hours; after which, the air being admitted, he continued without any ſigns of life for half an hour; but being carried into a ſun-ſhiny place, the beams of a declining ſun preſently began to make him ſtir his limbs, and in a little time reſtored him to life: One of thoſe ſhining beetles, called roſe-flies was included in a ſmall round receiver, on exhauſting the air, it ſtruggled much, but preſently after, a little motion was perceivable; in about ſix hours, it ſeemed quite dead, and on the return of the air, no ſign of life enſued for a pretty while, but in three or four hours more, it was lively enough: Butterflies being obſerved not only to live, but move longer than was expected, ſeveral of them were included in large receivers, and whilſt the air continued in the glaſſes they flew up and down, and tho' after the exhauſtion of the air, they continued to live, yet none of them was obſerved to fly, and frequently inverting the receiver, they would fall down

down like dead animals, without diſplaying their wings; tho' juſt as they came to touch the bottom, ſome of them would ſeem to uſe them, but not enough to ſuſtain their bodies, and break the rudeneſs of their fall.

A great many ants were included in a ſmall portable receiver; and they became almoſt motionleſs as the air was exhauſted; and in ſix or ſeven hours they ſeemed to be all quite dead; on opening the glaſs, tho' no ſign of life appeared for a great while, yet next morning they were found all alive and moving up and down: A great many mites together with the cheeſe they were bred in, were put into three or four ſmall receivers; one of them with the air in it, was ſealed up at a lamp furnace, and the air was withdrawn from all the others; upon which the following phænomena were obſerved; the mites, that were incloſed in the glaſs with the air, continued alive for above a week: In the exhauſted glaſſes, in a few minutes after exhauſtion, they diſcovered no ſigns of life; in two or three hours, the air was admitted, and the receiver left unſtopped in a window, and in two or three days after, a number of them revived: One of the receivers was kept exhauſted for two days, after which they gave no ſigns of life, at length the air was admitted, and after a long time, they were obſerved to creep up and down the glaſſes again.

Of the Magnetic Variation, *&c. by M.* Hevelius. Phil. Tranſ. N° 64. p. 2059.

ANNO 1642. M. *Hevelius* obſerved the declination of the magnet at *Dantzick*, as did alſo Mr. *Linnemannus* about the ſame time at *Koningsberg*; and they both found the declination to be 3° 5′ weſtward; but *June* 22 N. S. 1670, M. *Hevelius* obſerved it to be 7° 20′ to the weſt; ſo that in the ſpace of 28 years, that declination was increaſed 4° 15′ In 1620 he found it 1° weſtward, and this declination was ſaid by the learned *Peter Crugerus* to have been about the beginning of this century, or end of the preceeding 8° 30′ eaſt; whence it appears, that the declination of the loadſtone at *Dantzick* encreaſes each year 9′ 6″ which is ſufficiently confirmed by the obſervations made at *Limehouſe* near *London*, by *Burrows*, *Gunter* and *Gellibrand*, the firſt of whom found the declination *An.* 1580 to be 11° 16′; the ſecond, *Anno* 1622, 5° 36′ 30″; the third *Anno* 1634, found it 4° 3′ 30″. M. *Hevelius* cannot yet deviſe any cauſe of theſe appearances, unleſs we aſcribe them to a kind of libration in the earth's motion, and the variation of the meridian.

The

The ſame gentleman had received from one that lives on the *Baltic* ſea a piece of amber, ſo ſoft that it took the impreſſion of a ſeal; it was yellowiſh as moſt amber is, and tranſparent and burned as other amber does, but its ſcent was ſtronger, as if it were a kind of glutinous bitumen, tho' it had been caſt up by the ſea upwards of a year before: A very credible perſon informed M. *Hevelius*, that he had been maſter of a ſmall piece of amber, ſoft on one ſide, and very hard on the other, wherein a fly lay buried.

Animadverſions on Dr. Wallis's *Hypotheſis of the* Tides; *by* Mr. Joſ. Childrey. Phil. Tranſ. N° 64. p. 2061.

MR. *Childrey* apprehends that Dr. *Wallis* may be miſtaken as to the annual viciſſitudes of the tides, which the Doctor contends to happen about *All Hollond Tide* and *Candlemas*, and that for the following reaſons, 1. Our *Engliſh* ſeamen, who are in this caſe more to be regarded than the inhabitants of *Romney-Marſh*, uſe to ſay, that the higheſt annual tides ſeem to fall out rather about the equinoxes. 2. The high-tides in the *Thames* in *November*, if we may credit the *London* watermen, are cauſed by the coming down of land-floods, after great rains, which meeting the tide of flood from the mouth of the *Thames*, muſt ſwell very high; and to confirm this, we need only conſider, that the latter end of *October* and the beginning of *November*, or rather theſe two entire months, are generally the rainyeſt part of the whole year; now ſhould theſe floods happen either at full or change, as they did, according to *Stow* and *Howes* account, *Sep.* 30. 1555 and *Oct.* 22, 1629, the ſpring-tides muſt be the higher, as proceeding from a double cauſe. 3. There is another known cauſe of high and low-tides, *viz.* The ſitting of the wind at ſuch or ſuch a point of the compaſs, and its blowing hard; it is a common ſaying among all the ſeamen in *Kent*, that north-weſt winds make the higheſt tides in the *Thames* and *Medway*, and on all the coaſt of about the ſouth and north *Foreland*, as alſo on the coaſt of *Holland* and *Flanders*; and the reaſon they give for it, is, that that wind does with equal force blow in the tide of flood on both ſides of this iſland of *Britain*; that is, from the north between the coaſt of *Scotland*, *Norway* and *Jutland*, and alſo from the weſt, by the coaſt of *Cornwall*, *Devonſhire*, *Dorſetſhire*, &c. up along the *Channel*; and on the ſame account a ſouth-eaſt wind hinders the tides there; and the people about *Chatham*, the hundred of *Hoo*, and the iſle of *Graine* are never apprehenſive of their low marſhes being overflowed by the tide,

but

but when the wind is N. W. or thereabouts, in ſpring-tides; and M. *Childrey* remembers, when a boy at *Rocheſter*, that when tides were unuſually high, the wind was always N. W. and the moon near the full or change: And alſo at *Weymouth* a S. S. E. wind makes the greateſt tides; and always in proportion to the ſtrength of the wind, all other circumſtances being equal, the tides riſe more or leſs remarkably, and there are never any extraordinary ſwelling tides about *Allhollond-tide* or *Candlemas*, unleſs the wind be about S. S. E; and for the ſame reaſon a wind from the ſame point makes the higheſt tides at *Southampton*; a weſterly wind raiſes them at *Briſtol*, and in the *Severne*; an eaſterly at *Hull*; a north-eaſt wind at *Wisbych* and *Lynn*; a ſoutherly wind makes the greateſt tides on the oppoſite coaſts of *England* and *Ireland*, &c. The moon in her perigæum ſeems likewiſe to influence the tides, and to make them ſwell higher, than elſe they would do; which ſeems to agree with an obſervation among *Kentiſh* ſeamen, that they never have two running ſpring-tides, but that the next ſpring tide, after a high running one, is proportionably weak becauſe the moon being in her perigeum at this ſpring-tide ſhe will be in her apogæum at the next; and Mr. *Childrey* thinks this hypotheſis would be very much confirmed, were it obſerved, that thoſe neap-tides are higheſt, that happen at the moon's being in her perigæum either at firſt or laſt quarter; for then the moon is nearer the earth, than when ſhe is in her perigæum at full or change.

In anſwer to theſe objections, Dr. *Wallis* allows the winds to greatly influence the tides of particular coaſts and havens, as alſo land-floods; but that his deſign was to give a mechanical account of the ſtated periods, as the diurnal, menſtrual and annual tides, and not of accidental irregularities, ſuch as theſe are; and he alſo allows that the moon being in her perigæum and cauſing high-tides, is far from being contrary to his hypotheſis; but in regard it does not happen at the ſame time of the day, month or year, it could not be taken as a cauſe of thoſe noted periods, tho' it might very well influence any or all of them, as the moon happens then, to be or not to be in her perigæum.

But as to the matter of fact in *Romney-Marſh*, he ſays, that according to the beſt account, it is found conſtant, hardly miſſing any one year, be the weather fair or foul: And tho' the ſeamen at *Weymouth* have not obſerved any ſuch ſignal effects about *Allhollond-tide* and *Candlemas*, yet about *Chepſtow* the like is obſerved to happen about the beginning of *March*, and end of *September*, the one preceeding as much the vernal as the other follows

follows the autumnal equinox, and they call them St. *David's* ſtream, and *Michaelmas* ſtream.

Accidents by Lightning *at* Stralſund *in* Pomerania. Phil. Tranſ. N° 65. p. 2084.

JUNE $\frac{12}{29}$ 1670, being ſunday, a dreadful flaſh of lightning, like a black fiery ball, darted thro' a large round hole in the upper vault of St. *Nicholas* church, directly upon the altar, cauſing ſuch a fearful crack, flaſh and ſmoke, with a ſulphureous ſmell, as if ſeveral fire-balls had been thrown down and burſt all at once; the candle on the ſouth ſide of the altar was extinguiſhed by the blow; two of the chalices were overthrown, the wine ſpilt, and the wafers ſcattered about, but the empty chalice ſtood firm, and all three were ſomewhat ſmutted in the foot, as likewiſe the wafer-boxes towards the bottom; and one of the chalices was pierced thro' in two places, as if it had been by hail-ſhot; the church book was flung on the inner paſſage; the covers of the altar were ſinged in ſeveral parts, as if it were by powder, and ſomewhat burnt, and ſmutted here and there, as alſo torn in ſome places; a ſtrong piece of wainſcot, with a picture on it, behind the great altar, was ſplit in two; both the braſs and iron wires of the whole and quarter-hour hammers of the church-clock were partly broken, and the reſt could not be found; and an oaken poſt, fixt in the wall for the ſupport of the dial, was half torn, and beneath the ſame ſeveral bricks were ſtruck out of the two head pillars, ſupporting the ſteeple; on the top of the ſouth ſteeple an oaken gutter, and a ſtrong beam and ſupporter were ſhattered; one of the miniſters, tho' ſitting near the altar to the ſouth, had no hurt at all; ſeveral of the people ſeated round the altar fell down with the fright; on the north-ſide of the altar four perſons fell down; and ſome that ſtood in or by the belfrey, near the clock were ſlightly hurt here and there, and one leaning on a lined oaken ſeat, had his right arm bruiſed; there iſſued with great violence out of the ſouth ſteeple, upon opening the windows a great damp like ſmoak; but there appeared no fire, ſave a little in the ſhattered parts of the ſteeple, which was ſoon quenched; the church dial was ſmutted in ſeveral parts, ſo that the gilt figures could not be diſcerned, as alſo the gilt weather-cocks on the ſteeples, on one ſide of their tails: It was afterwards obſerved, that of the eight perſons that were hurt, one who ſtood in the belfrey, had the upper back part of his coat, as alſo his ſhirt and ſkin ſomewhat torn, and yet the lining of red frize was not touched; he that had

had his arm bruiſed, had a hole thro' his coat, waſtcoat and ſhirt, on the fore-part of his body, appearing as if ſhot thro', yet without the leaſt hurt; his waſtcoat of red ſarcenet kept its colour every where, except where the arm was hurt; and the ſmall ſilver edging was all over ſmutted; one half of his ſhoe was torn off, and the ſole pierced as with hail-ſhot, and near a hands breadth of the foot of his ſtocking was ſtruck away, without any other hurt in either foot or leg, except that for ſome days after he had a numbneſs in that foot; one of thoſe that ſat by the altar had his breeches and leather-drawers pierc'd thro' on each ſide as with hail-ſhot, and ſome parts were viſibly ſcorched and ſhrunk up, as if it were by fire, and many of theſe ſmall holes were obſerved in his ſhirt, without any hurt in his body, ſave a little pain he felt in his foot; one ſide of his ſhoe was torn off, and the ſole was pierc'd thro' as with hail-ſhot.

Of a new Star *diſcovered in* Cygnus; *by* M. Hevelius Phil. Tranſ. N° *65*. p. 2087. *Tranſlated from the* Latin.

AUguſt $\frac{17}{27}$ 1670, *M. Hevelius* obſerved near and below the head of *Cygnus*, among the unformed ſtars, a ſtar almoſt of the third magnitude, whoſe longitude was 1° 52′ 26″ *Aquarius*, and N. Lat. 47° 25′ 22″: When he firſt obſerved this ſtar, as to magnitude and brightneſs, it was equal to that in the breaſt of *Aquila*, excepting only that its light was ſomewhat duller; with reſpect to the other ſtars, it was ſituated in a right line with that in the angle or bend of the ſuperior wing of the ſwan, and with the ſtar in the eagle's ſhoulder, as alſo with *Lucida Lyræ*, and the more northerly of the middle ſtars in the *Rhombus Delphini*; and it conſtituted an equilateral triangle with the two ſtars in the head and bill of the ſwan: The new ſtar in the ſwans breaſt which appeared 1600, ſeemed then to increaſe gradually, tho' ſtill not bigger than one of the ſixth magnitude.

Don Anthelme, a *Carthuſian* at *Dijon*, did on the 20th of *Dec.* 1669 diſcover a ſtar of the third magnitude beneath the head of *Cygnus*, ſituated in the ſection of the two ſtreight lines, one of which goes from *Lyra* to the neareſt of the *Rhombus Delphini*, and the other from the eagle to the ſtar, which is on the top of the upper wing of *Cygnus*; He communicated this diſcovery to M. *L'Abbe Mariotte*, who imparted it to the Royal Academy, and they all agreed that it was a new ſtar.

Of

Of Refpiration, *&c.* *by* Laur. Bellini. Phil. Tranf. N° 65. p. 2093. *Tranflated from the* Latin.

THE air rufhes into the *Afpera Arteria* or wind-pipe, with a momentum compounded of its gravity and lateral force, which latter counterpoifes the preffure of the external air; hence the mufcles defigned for infpiration are fuffered to contract, the ribs are elevated, and the cavity of the thorax is enlarged; and then the irruption of the air and the expanfion of the pulmonary ducts are promoted, and this is called infpiration: Again, the ribs falling by their own weight upon the diftended lungs, the cavity of the thorax becomes ftraighter, by which and the diaphragm the lungs are compreffed, and the air is partly difcharged at the mouth, and partly impelled into the fmalleft veffels, into whofe cavities it could not otherwife penetrate by its own weight, till the lungs do entirely fubfide, and this is exfpiration; and thus the entire action of refpiration is performed: The mufcles of the thorax are difpofed according to mechanical laws, and their force is proportionable to the refiftance to be overcome, and by a certain fublime geometry they dilate its cavity; the ribs in exfpiration do fubfide of themfelves by means of their figure, pofition and articulation. The only ufe of the air in the lungs feems to be to propel the blood from the capillary arteries to the capillary veins, or from one ventricle of the heart to the other, whereby the blood, in its paffage thro' the lungs is comminuted: A too thin, or too denfe an air is unfit for refpiration, as hindering the circulation of the blood through the lungs.

The bile flows from the liver and gall-bladder into the inteftines, and not on the contrary, nor is it difcharged into the *Cava*; and it is compreffed out of the gall-bladder by the ftomach diftended with food, and by the fame compreffing force the pancreatic juice is alfo difcharged into the *Duodenum*, by the commixture of both which the chyle is elaborated.

A monftrous Birth; *by* Dr. Durfton. Phil Tranf. N° 65. p. 2096.

THIS birth, as appears by Fig. 9. Plate IX. had two heads and two necks, as alfo the eyes, mouth and ears double, four arms and hands and as many legs and feet; but there was only one trunk, and two back-bones; from the clavicles to the *Hypogaftrium*, and from the fhoulders down to the bottom of the loins, they were united and incorporated in

this manner; the right clavicle of the right hand child was joined to the left clavicle of the left hand child; the ribs on the anterior ſide of both were united by the cartilages without any intervening *Sternum* or breaſt-bone, and ſo made a common cheſt for both, and the ribs of both on the back-part were united by cartilages; and from the clavicle down to the *Hypogaſtrium*, they were ſo united as to have but one common *Abdomen*, with one navel-ſtring, but from the *Hypogaſtrium* downwards they were divided, and became two, each having the perfect parts of females: This birth weighed 8 $\frac{1}{4}$ pound, the circumference of the left head was about 11 inches, and the right $\frac{1}{2}$ inch leſs; the circumference of the trunk was about 16 $\frac{1}{4}$ inches, and the length of both from head to foot, was full 18 $\frac{1}{2}$ inches; they had one umbilical vein, and one very large liver, with the gall-bladder in its uſual place; there were too urinary bladders, two wombs, four kidneys, and one ſtomach, with the *Oeſophagus* or gullet perforated and open from the mouth of the left head, but the *Oeſophagus* from the mouth of the right head deſcended no lower than a little above half an inch of the midriff, and there it ended; whence it may be concluded, that the right hand child muſt have received its nouriſhment from the left child; there was only one colon, which terminated in two *Inteſtina Recta*; and there was but one midriff, and above that no appearance of lungs, only a very large heart with two auricles, not conical but of the figure of a ſtomach, and lying near to and under the clavicles, in a tranſverſe poſition, the heart was alſo obſerved to have two ventricles with the tricuſpides and ſigmoid valves, with the *Vena Cava* and *Aorta deſcendens*, as alſo the *Aorta aſcendens*, bifurcated towards each neck, and then divided a ſecond time: Theſe twins exactly reſembled each other, their features were very good, and their limbs neat and handſome, their hair was more than ordinary thick, and about half an inch long, and their nails full grown.

Inſects *lodging themſelves in old Willows; by* Sir Edm. King. Phil. Tranſ. N° 65. p. 2098.

IN an old willow were found ſeveral inſects curiouſly wrapt up in green leaves, in ſeveral channels or burrows, each with 12, 14 or 16 leaves round the body, and many of them with little round bits of leaves at each extremity, to ſtop them up cloſe; thus made up, they are near an inch long, placed one after another in a bore in the wood for their reception, like car-

cartridges of powder; in ſome they touch, in others, they are at a conſiderable diſtance; in theſe ſomething is found alive, or the appearance of ſomething that died there, and is putrified; in ſome a great number of mites, of a dark aſh-colour; in others, ſeeming excrements of ſome ſmall inſect; in others, white maggots; upon taking out ſome of theſe maggots out of their *Thecæ* or caſes and putting them in the ſun, they grew ſomething bigger but without changing either ſhape or colour, they died; and keeping the reſt cloſe ſhut up in a box for ſome time, and afterwards opening the leaves, there came out a perfect bee.

Mr. *Willoughby* adds, that the leaves in which they are wrapped up are roſe-leaves; and that the *Cuniculi* or holes never croſs the grain of the wood, except where the bee comes in, and where they open into each other; and from the place of entring, they are wrought both upwards and downwards; ſo that ſometimes the bee maggot lies under her food and ſometimes above it; the end of the cartridge next the entry, is always a little concave; the other extremity, furtheſt off, a little convex, which is received into the concavity of the next beyond it; the ſides of the cartridges are made up of oblong pieces of leaves, paſted together, the extremities conſiſt of round leaves; and where-ever they do not lie cloſe to each other, the intermediate ſpace is filled up with a number of theſe little round pieces, laid on each other: The cartridges contain a pap of the conſiſtence of jelly, or a little thicker, of a mean colour between ſyrup of violets and conſerve of red roſes, of an acid taſte and unpleaſant ſmell; in each of theſe, at the concave end, lies a bee-maggot, which feeds on the above pap, till it arrives at its full bigneſs, and then it encloſes itſelf in a caſe of a dark red colour and oval figure, in which it is changed into a bee, what remains of its food is found dried into powder at the convex end. Theſe bees are ſhorter and thicker than the common honey-bee, more hairy, &c. but the ſureſt mark to diſtinguiſh them by, is, that the *forcipes*, or teeth of theſe are bigger, broader and ſtronger; in ſhape they reſemble a waſp or hornet, but with a tongue like a bee: Of the matter within the caſes, when the bee-maggots happen to miſcarry, are bred little hexapodes, which produce beetles; two maggots, which produce flies; three mites, &c. The parent-bee, when ſhe has left proviſion enough with an egg, cloſes up the cartridge; and the maggot, a great while after, makes the *Theca* or caſe; Fig. 10. Plate IX. repreſents the leaf, out of which, a long piece, as Fig. 11. and a round piece,

as Fig. 12. were bitten; Fig. 13. ſhews the cartridge itſelf and Fig. 14. the *Theca.*

Spiders *darting their Threads; by Dr.* Hulſe. Phil. Tranſ. N° 65. p. 2103.

MR. *Wray* had the firſt hint of the darting of ſpiders from Dr. *Hulſe*, and afterwards from Dr. *Liſter*; the former obſerving, that ſpiders ſhoot three yards of thread before they begin to ſail, and then they fly away with incredible ſwiftneſs, at which appearance he was a little puzzled, ſince ſometimes the air does not move a quarter ſo faſt, as they ſeem to fly; generally they project their threads ſingle, without any diviſion to be ſeen in them; ſometimes they will ſhoot their thread upwards, and mount up with it in a perpendicular direction; and at other times, they dart in a line parallel to the horizon, as may be ſeen from their threads reaching from one tree to another; and this laſt obſervation made Dr. *Hulſe* think, that ſpiders could fly; the way of forking their threads, is repreſented Pl. IX. F. 15, poſſibly their threads by being thus winged, are better able to ſuſtain them in the air; they will often faſten their threads in ſeveral places to the things they creep over, which they do by beating their tails againſt them, as in Fig. 16, by which they ſecure their thread againſt the wind, or while they hang by it; for if one ſtick ſhould break, another may hold faſt, and ſo ſecure them from falling to the ground.

A Rock *of natural Salt in* Cheſhire; *by Mr.* Adam Martindale. Phil. Tranſ. N° *66.* p. 2015.

IN *Cheſhire* is found a rock of natural ſalt, from which iſſues a brine ſtronger than any of the ſprings made uſe of in our ſalt-works, it is about 34 yards deep in the earth; and a piece taken up by the auger was as hard and pure as alum, and when pulverized, it became a fine and ſharp ſalt.

An Eclipſe *of the* Moon; *a Conjunction of* Venus *and the* Moon, *&c. by* M. Hevelius. Phil. Tranſ. N° *66.* p. 2023. Tranſlated from the *Latin.*

SEPT. 29th, *N. S.* 1670, in the morning, the beginning of the eclipſe was about 2 hours 22 minutes, tho' it could not be accurately obſerved, on account of the earth's ſhadow being very faint; for during the whole eclipſe, the ſhadow was ſo thin and diluted, that all the principal ſpots could be ſeen thro' it with a teleſcope of 20 foot, and even a ſhorter; the great

greateſt obſcuration was about 3 h. 50 m. the end of the eclipſe was 5 h. 21 m. the whole duration therefore was 2 h. 59 m. and the quantity of it was ſcarce more than 9 digits.

According to the *Rudolphin* tables	h.	m.	ſec.	According to *Riccioli*'s tables.	h.	m.	ſec.
The beginning	2	37	55	The beginning	2	14	47
Greateſt obſcurat.	4	2	50	Greateſt obſcurat.	3	55	37
The end	5	28	35	The end	5	36	27
Whole duration	2	51	30	Whole duration	3	21	40
Quantity of digits	9	4	0	Quantity of digits	11	43	0

About the middle of this eclipſe 3 h. 40 m. he clearly obſerved an unknown teleſcopic ſtar covered by the moon near the *Lacus niger major*; after the eclipſe was over, it was a pretty agreeable ſight to obſerve both luminaries at once above the horizon, for before the moon's ſetting the ſun roſe.

Octob. 11th, *N. S.* about 8 o'clock in the morning, after ſunriſing, *M. Hevelius* alſo obſerved at *Dantzic*, a conjunction of *Venus* and the moon; and according to the *Rudolphin* tables, there muſt have been an occultation of at leaſt 23″ by the inferior limb of the moon; he had furniſhed himſelf with a 20 foot teleſcope, and tho' the air was not entirely clear, there being here and there a few clouds, yet *Venus* and the moon were clearly obſerved, but there happened then no occultation, *Venus* being at the diſtance of 3 or 4 min. from the inferior limb of the moon, but only a cloſe tranſit; this was a very agreeable ſight in the day-time and in ſun-ſhine, for the moon was very ſmall and ſlender, haſtening to her conjunction, and her horns were very ſharp; and *Venus* was almoſt full, with her body much diminiſhed: On the ſame day 7 h. 40 m. three parhelia appeared.

The new ſtar, under the head of *Cygnus*, which at firſt appeared of the third magnitude, was in a ſurpriſing manner diminiſhed in the month of *September*, ſo that on the 14 of *October* it could be no longer obſerved: The other new ſtar in the neck of *Cetus* was almoſt, till the middle of *October*, equal to the ſtar in the jaw, and nearly exceeding it in brightneſs and magnitude, ſo that this year it was of the ſecond magnitude, and larger than it was the preceeding years, excepting that in 1660, he obſerved it to exceed the ſtar in the jaw; at other times, he did not find it ſurpaſs a ſtar of the third magnitude; it is therefore certain, that it is not always of the ſame magnitude and brightneſs when largeſt; it was lately much diminiſhed.

Expe-

Experiments on Iceland Cryſtal; *by* Eraſm. Bartholin. Phil. Tranſ. N° 67. p. 2041.

THIS kind of cryſtal is found in ſeveral parts of *Iceland*, but chiefly dug out of a very high mountain, not far from the bay of *Roerfiord* in 65 degrees of latitude, all whoſe outſide conſiſts of this ſubſtance; it is cut out by iron tools into pieces of a cubic foot, and in ſome of its corners is found a harder matter, very proper for cutting glaſs, of a different figure from the whole maſs, and reſembling that of a diamond: The figure of this cryſtal ſtone, and all its parts, when broken into ſmall pieces, is a rhombus or rhomboid priſm; except a few which are of a triangular pyramidal figure: This ſubſtance is electrical, attracting, when heated, ſtraw, feathers, &c. It is not ſo hard as to bear poliſhing; nor is it eaſily conſumed, nor reducible into a calx, but by a ſtrong fire, by which it will turn to a ſubſtance like unſlacked lime, heating a wet finger, and when ſprinkled with fountain water, will bubble up, and become like common lime: It is corroded by dropping *Aqua-fortis* upon it, and the ſuperficial parts are put into motion with a hiſſing noiſe; pouring *Aqua-fortis* on it, when pulverized in a mortar, makes it boil, till all is diſſolved, and the *Menſtruum* tinged with a yellowiſh colour; then putting it into a thermometer with a hollow glaſs-ball, it remarkably ſhewed the difference of heat and cold: The ſides of this body are exceeding ſmooth; the whole body is rather clear than bright, of the colour of limpid water, but when immerſed in water, and dried again, it becomes of a dull colour; hence it is, that in its native place, the upper ſurface is darkiſh, from the fall of rain and ſnow upon it: Sometimes there appear colours in it, as in the rainbow; the angles are not pointed alike, all the flat ſides being obliquely inclined to each other; the oppoſite planes are parallel: In this cryſtalline priſm, two of the plain angles are always acute, and the other two obtuſe; and never any of them equal to the collateral angles of the inclinations: The objects, ſeen thro' it, appear ſometimes, and in certain poſitions of the priſm, double; where it is to be noted, that the diſtance between the two images is greater or leſs, according to the different bigneſs of the priſm; inſomuch, that in thinner pieces, this difference of the double image almoſt vaniſhes; both images appear with a fainter colour, and ſometimes one part of the ſame image is obſcurer than the other, and one of the images appears higher than the other: In a certain poſition, the image of an object appears only ſingle; there is

alſo

alſo a poſition, in which the object appears ſix-fold: If any of the obtuſe angles of this priſm be divided into two equal parts by a line, and the viſual rays paſs from the eye to the object thro' the line, or its parallel, both images will meet in that line, or in another, parallel to it: Whereas, objects, ſeen thro' diaphanous bodies, are wont to remain conſtantly in the ſame place, in what manner ſoever the tranſparent body be moved, and the image on the ſurface does not move, unleſs the object be moved; here it is obſerved, that one of the images is moveable, the other remaining fixt; altho' there be a way, to make the fixt image moveable, and the moveable fixt in the ſame cryſtal; and another method of making both moveable: The moveable image does not move at random, but always about the fixed, which turning round, never deſcribes a perfect circle, but in one caſe: We learn from dioptrics, that a diaphanous body, with one only ſurface, ſends from one object but one image refracted to the eye; and having more ſurfaces than one, it repreſents an image in each; but in this cryſtal, there is but one plain ſurface to the eye, and yet a double image of one and the ſame object, which ſeems to ariſe from a double refraction; that refraction, which cauſes the fixt image, may be called the uſual refraction; the other that tranſmits the moveable image, the unuſual refraction; for in the former caſe, the eye remaining ſteady, and the diaphanous body moved, that image remains always fixt, as long as the object, whence it proceeds, remains unmoved; wherefore, in this tranſparent ſubſtance, the image that appears fixt, may proceed according to the ordinary laws of uſual refraction; but the moveable image, and which is carried about according to the motion of the diaphanous body, while the object remains fixt, ſhews an unuſual kind of refraction, hitherto unobſerved by dioptric writers: Hence, that the nature and difference of both might be examined, the double refracting priſm N P R Q T B S Plate IX. Fig. 17. was put on the object A; and the eye M being in a perpendicular poſition to the upper plane of the priſm, *viz.* N P R Q, the perpendicular ray was obſerved to paſs, not thro' the moveable but the fixt image, according to the rules of uſual refraction, as ſtriking the eye unrefracted, ſo that the eye, the image, and the object, were ſeen in the ſame line; but, when in the ſame ſight of the eye, the object A, did alſo exhibit the other image X, at no ſmall diſtance from the former, it was obſerved that this object A, was not ſeen unrefracted by means of the image X, tho' the eye M

remained perpendicular over the plane, and therefore this unuſual refraction varies from that received axiom in dioptrics, that a ray falling perpendicularly on the ſurface of a diaphanous body, is not refracted, but paſſes unrefracted: Again, placing the eye in O, that the ray from the object A, coming to the eye, might be parallel to the lines R T and Q B of the plane R Q T B, then it appeared, that the rays were tranſmitted from the object A, without refraction, thro' the moveable image Z, the object A, the moveable image Z, and the eye O, being in the ſame line; and that the ſame object A, did tranſmit to the eye O, remaining in the ſame poſition, another ſpecies Y, thro' the refracted ray A Y O; whence it is manifeſt, that this unuſual refraction had for its rule the parallel of the ſides of this double refracting cryſtal, while the uſual refraction was directed according to the perpendicular to the ſurface: But conſidering that the place of the point, appearing thro' the cryſtal, cannot eaſily be determined, as being only obvious in the uppermoſt part; here is ſubjoined the method, whereby to find its diverſity, by drawing on the ſubjacent table, a ſtreight line thro' that point; the place of which line will be determined by one eye thro' this cryſtal, and by the other without the cryſtal, for let a ſtreight line B C be drawn thro' the object A; the eye being in M, H D and I E will appear the images caſt on the upper ſurface, and it will be obſerved that the fixt image H D will be congruent to the ſubjacent line B C, whilſt the other moveable image I E, tends towards R; but if afterwards the eye be poſited in O, the ſame object, *viz.* the line B C, will not only be repreſented double by the images K F and L G, but alſo the moveable image L G will be congruent to the inferior line B C, while the fixt image F K tends towards N. After this the author proceeds to determine the quantity of the refractions in this body; and he finds, after ſeveral trials, that the angle of inclination is to the angle of refraction as 5 to 3: It has been further obſerved, that ſome rays paſs unrefracted even in lines not perpendicular to that body; and again, that half the light from the object is refracted according to the uſual, and half according to the unuſual refraction.

A Method of making Sea-Water *ſweet; by M.* Hauton. Phil. Tranſ. N° 67. p. 2048.

THE ſecret of making ſea-water ſweet, conſiſts firſt in a precipitation made with oil of tartar; and then in diſtilling the ſea-water; the furnace for this purpoſe takes up but little

little room; and it is ſo made, that with a little wood or coal, twenty-four pots of water may be diſtilled in a day; the worm is made to paſs thro' a hole out of the ſhip, and to enter in again at another; by which means, the room the refrigeratory or cooler would take up, as alſo the labour of changing the water is ſaved; to the three preceeding operations filtration is added, that thereby the malignity of the water may be corrected; this filtration is made with a peculiar earth, which is mixed and ſtirred with the diſtilled water, and which at length ſettles at the bottom. M. *Hauton* maintains, that this diſtilled water is very wholeſome, having been given both to men and beaſts without any ill effect, and that that peculiar earth mixed with the diſtilled water blunts the points of the volatile ſpirits of the ſalt, and ſerves them for ſheaths.

A new Urinary Paſſage *into the Bladder.* Phil. Tranſ. N° 67. p. 2049.

A Dog was made to drink a good quantity of water, after firſt tying up his ureters, and emptying his bladder; and after two hours the bladder was found empty, and the ureters were not obſerved tumid above the ligature; upon ſuſpecting that this might be owing to the cooling of the inward parts, which had been all this while expoſed to the air, the inciſion having been made croſs-wiſe after the ordinary manner; to avoid this inconvenience, the experiment was repeated on another dog, by making a ſmall orifice on each ſide, ſufficient for finding and tying the ureters, and ſqueezing out the urine out of the bladder; and then the orifices were ſowed up again, and the dog made to drink a good deal of water; in three hours after, upon opening both the orifices, and preſſing the bladder with the hand, there iſſued out of it a good deal of urine, and the ureters ſeemed to be a little ſwelled above the ligature.

Wood *found under Ground in* Lincolnſhire. Phil. Tranſ. N° 67. p. 2050.

THAT fenny tract, called the iſle of *Axholme*, which lies partly in *Lincolnſhire*, and partly in *Yorkſhire*, and extends a conſiderable way, was anciently a woody country, as appears from the quantity of oak, fir, and other trees found in the *Moors*; ſome of theſe oaks are five yards in compaſs, and 16 yards long, others ſmaller and longer, and near them great numbers of acorns are found, and the trees lie above 3 foot deep; and near their roots, which ſtill ſtand as they grew, *viz.*

in firm earth below the *Moors*; the firs lie a foot or 18 inches deeper, and are in greater numbers than the oak, and many of them 30 yards long, and one was taken up of 36 yards excluding the top, lying alſo near its root, which ſtood as it grew, having been burnt and not cut down, in the ſame manner as the oak. Mr. *Dugdale*, in his book of *Draining the Fens in England*, relates that the inhabitants had for many years taken up many cart-loads of theſe trees in a year; and ſays, that the depth of the *Moor* evinces it to have been of ſeveral hundred years ſtanding, and he thinks it had its original from the muddineſs of the tides, which flowing up *Humber* into *Trent*, left in time ſo much filth, as to obſtruct the currents of *Idle* and *Dun*, and other rivers which were forced to flow back, and ſo overflow'd that flat country.

A Stone-Quarry *near* Maeſtricht. Phil. Tranſ. N° 67. p. 2051.

WITHIN a cannon-ſhot of *Maeſtricht* in a hill, is an excellent quarry, where there are about 25 fathoms of rock and earth over head, it has one entry on the brink of the river *Maeſe*, where carts can paſs with great eaſe, and unload the ſtones on the bank of the river; the quarry within lies level or parallel to the horizon, and very little elevated above the river: It affords one of the moſt ſurpriſing proſpects one can imagine, when well lighted with torches; for there are thouſands of ſquare pillars in large level walks, and ſome above 20 foot high, and others much higher, and all wrought with ſo much neatneſs and regularity that one would take it for a ſubterraneous palace: When armies march this way, the quarry ſerves for an impregnable retreat for the people that live thereabouts, for they convey thither their horſes, cattle, and moveable furniture, till the danger is over, and it is capable of ſheltering 40000 people. There is but little rubbiſh in this quarry, which ſhews both the goodneſs of the ſtone, and the carefulneſs of the workmen; and in ſeveral places are little pools of water, which perhaps have been made on purpoſe for beaſts to drink, and other uſes; for there are no droppings obſerved there, nor are the walks wet under foot, only rain gets in by the air-ſhafts, which, for ſaving of labour, and perhaps too, for making theſe pools, are let down from ſuch places, as are commonly pools; and ſo the rain that falls on the higher ground, eaſily finds the way thither.

Acid

Acid Juice *of* Pismires; *by* Mr. J. Wray. Phil. Transf. N° 68. p. 2063.

DR. *Hulse* communicated the following observation to Mr. *Wray*, *viz.* that if you lay bare an ant-hill with a stick, and then throw cichory-flowers upon it, the flowers will become red as blood; *Langham* mentions this in his *Garden of Health*, but he was not the first that observed it; *Hieronymus Tragus Hist. Stirp. l.* 1. *c.* 91. takes notice of the same thing, and before him *Otho Brunsfelsius*, according to *John Bauhinus*; but they give no account of the manner how the flowers come to be stained, which is this; upon throwing in the cichory-flowers you will observe the ants creep very thick over them, at which time they let fall a drop, which, wherever it lights produces in a moment a large red stain; and bruising the ants and rubbing the expressed juice on the flowers, hath the same effect; and the Dr. thinks that the smarting pain they cause in the skin is owing to this corrosive liquor, rather than their stinging; but to what class he should reduce this juice, he was at a loss; he dropt spirit of salt and oil of sulphur upon the flowers entire and unbruised without any change of colour; but any acid spirit dropped on any blue flowers a little bruised, will turn them instantly red; he also put salt of tartar upon them, and dropped a little spirit of salt, which caused a sufficient fermentation, but did not change the colour of the flowers in the least.

Mr. *Sam. Fisher* of *Sheffield* communicated also these experiments, *viz.* if you stir with a staff or other instrument an heap of ants, especially horse-ants, in such a manner as to irritate them, they will drop a liquor thereon, which, if presently smelled to, will twinge the nose, like new distilled spirit of vitriol; which observation, together with this other, *viz.* that oil or spirit of vitriol will soon turn the syrup of violets, or the juices and tinctures of any other flowers of the like colour to a bright red, was inducement sufficient to be of the opinion; that the liquor of pismires might be of the same nature with acid spirits. Mr. *Fisher* further observed, that a weak spirit of pismires will in an instant turn borage flowers red, and that vinegar, a little heated, has the same effect; that pismires, distilled either by themselves or with water, yield a spirit like that of vinegar, or rather like the spirit of verdegrease; that lead put into this spirit, together with the live animals themselves, or into fair water, makes a good *Saccharum Saturni*,

that

that iron put into the ſpirit, affords an aſtringent tincture, and by a repetition a *Crocus Martis*: Take *Saccharum Saturni* thus made, and diſtill it, and it will afford the ſame acid ſpirit again, which the *Saccharum Saturni* made with vinegar will not do, it only yielding an inflammable oil with phlegm without any acidity: *Saccharum Saturni* made with verdegreaſe has the ſame effect, in this reſpect, as that made with ſpirit of piſmires: When you put the animals into water you muſt ſtir them, for when irritated they will ſpirt out their acid juice; all other animals except ants, that Mr. *Fiſher* ever diſtilled, yielded an urinous ſpirit.

Of the Julus *yielding an acid Juice, and of the Bleeding of a* Sycamore; *by* Dr. Liſter. Phil. Tranſ. N° 68. p. 2067.

DR. *Liſter*, obſerving that a piſmire bruiſed and ſmelt to, emits a ſtrong fiery and penetrating ſavour, like the leaf of the herb, called *Flammula* by Botaniſts, broken at the noſe, found by this means an inſect, which he ſuſpected would yield an acid liquor like piſmires, which is the long and round-bodied red-coloured *Julus*, frequently found in drier rubbiſh, diſtinguiſhed from all other *Millepedes*, in that their numerous legs are as ſmall as hairs, and white, and that in creeping they move like waves; the body of this *Julus* being bruiſed ſtrikes the noſtrils exceeding fiercely.

As to the bleeding of ſycamores Dr. *Liſter* obſerved at *Nottingham*, that the wounded ſycamores never bled either in *November*, *December*, *January*, *February* or *March*, unleſs a froſt preceeded; that froſt did not always ſet them a-bleeding at the wounds made before it came, tho' ſometimes it did, but upon its breaking up, or relenting very much, the wounds either made at that inſtant of time, or many months before, never failed to bleed more or leſs; that particularly on the breaking up of two great froſts, the former on the third of *Jan.* and the latter about the middle of *Feb.* all the wounds ran very plentifully; ſo that ſuch times may be looked upon, as the moſt proper ſeaſon of gathering great quantities of juice from this tree. Wounding ſome ſycamores at *Craven* in *May*, they did not bleed, either the remaining part of that month or the following months of *June* and *July*, but had the orifice of the wounds, made with a ſmall auger, in a manner quite cloſed up, ſcarce admitting a pigeon's feather; *July* 30th he cut out a ſquare piece of the bark, of about two inches, of a large and well-grown ſycamore; this wound began to run next morning

ing about nine o'clock, ſhedding a few drops, and drying up again about 11; a like inciſion was made in a young ſycamore *Aug.* 8th, which in like manner bled next morning, but ceaſ-ed before nine o'clock, and it did ſo for two or three days, and then it was totally dried up. *Nov.* 1ſt at *York* he pierced, and otherwiſe wounded, two ſycamores, growing in a wet clay, but they did not bleed till the beginning of the following *Feb.* yet Mr. *Wray* aſſures, that thoſe of *Warwickſhire* bled copiouſly, *Nov.* 16, and after that the walnut-trees in like manner.

Of the running of Sap *in* Trees; *by* Dr. Tonge. Phil. Tranſ. N° 68. p. 2070.

DR. *Tonge* is of opinion that trees and other plants would far better indicate the alteration of weather, as to heat and cold, moiſture and drought, than any weather-glaſſes; for ſome trees that ran tolerably in the forenoon, were obſerved not to yield a pint of ſap in the afternoon, and yet the weather-glaſs continued at the ſame height all the time, and tho' one of them ran moſt part of the day, the others ceaſed about one or two o'clock in a fair, clear ſun-ſhiny ſeaſon, occaſioned, as far as could be obſerved by a weſterly wind, tho' that wind be reputed mild and cheriſhing.

A Solution of a Chorographical Problem; *by* Mr. John Collins. Phil. Tranſ. N° 69. p. 2093.

THE diſtances of three objects in the ſame plane being given, as A, B, C; the angles made at a fourth place in the ſame plane, as at S, are obſerved: The diſtances from the place of obſervation to the reſpective objects, are required.

The problem has ſix caſes. *Caſe* 1. If the ſtation be taken without the triangle made by the objects, and in one of its ſides produced, as at S Fig. 18. Plate IX. find the angle A C B; then in the triangle A C S, all the angles and the ſide A C are known; whence any one, or both the diſtances S A or S C may be found.

Caſe 2. If the ſtation be in one of the ſides of the triangle, as in Fig. 19. at S, then having the three ſides A C, C B, B A given, find the angle C A B; then again in the triangle S A B, all the angles and the ſide A B are known, whence may be found, either A S or S B, geometrically; if you make the angle C A D equal to the obſerved angle C S B, and draw B S parallel to D A, you determine the point of ſtation S.

Caſe

Case 3. If the three objects lie in a right line as A C B Fig. 20. and suppose it done, and that a circle passes thro' the station S, and the two exterior objects A, B; then is the angle A B D equal to the observed angle A S C (by 21 3. *Euc.*) as insisting on the same arch A D; and the angle B A D, in like manner, equal to the observed angle C S B; by this means the point D is determined; join D C, and produce the same, then a circle passing thro' the points A, B, D, intersects D C produced at S, the place of station.]

Calculation. In the triangle A B D, all the angles and the side A B, are known, whence the side A D may be found: Then in the triangle C A D, the two sides C A and A D, are known, and their contained angle C A D is known, whence may be found the angles C D A and A C D, the compliment whereof to a semi-circle is the angle S C A; in which triangle all the angles are now known, with the side A C; whence either of the distances S C or S A may be found.

Case 4. If the station be without the triangle, made by the objects the sum of the angles observed is less than two right angles; both the construction and calculation are the same as in the last case; only you must make one operation more; having the three sides A C, C B, B A Fig. 21. thereby to find the angle C A B, which add to the angle B A D, then you have the two sides, *viz.* A C one of the distances, and A D, found as in the preceeding case, with their contained angle C A D given, to find the angles C D A, and A C D, whose complement to a semi-circle is the angle S C A; now in the triangle S C A, the angle at C being found, and that at S observed, and given by supposition, the other at A is likewise known, as being the complement of the two former to a semi-circle, and the side A C is given; hence the distances C S or A S may be found.

Case 5. If the place of station be at some point within the plane of the triangle, made by the three objects, the construction and calculation are the same, as in the last case, only that instead of the observed angle A S C, the angle A B D is equal to the complement thereof to a semi-circle, *viz.* equal to the angle A S D, both of them insisting on the same arch A D: And in like manner, the angle B A D is equal to the angle D S B, the complement of the observed angle C S B; and in this case the sum of the three angles observed, is equal to four right angles.

In these three latter cases, no use is made of the angle observed between the two objects, A, and B, which are made the

the baſe-line of the conſtruction; yet the ſame is of ready uſe for finding the third diſtance, or laſt ſide ſought, as Fig. 22. in the triangle S A B, there is given the diſtance A B, its oppoſite angle equal to the ſum of the two obſerved angles, and the angle S A B found, as in the fourth caſe; hence the third ſide or laſt diſtance S B may be found: And here it may be noted, that the three angles C A S, A S B, S B C are together equal to the angle A C B; for the two angles C S B and C B S are equal to E C B, being the complement of S C B to two right angles; and the like in the triangle on the other ſide. Therefore, &c.

Caſe 6. If the three objects be A, B, C, Fig. 23. and the ſtation at S as before, it may happen, according to the former conſtructions, that the points C and D may fall cloſe together, and ſo a right line joining them will be produced with uncertainty; in that caſe, the circle may be conceived to paſs thro' the place of ſtation at S, and any two of the objects as thro' B and C, wherein making the angle D B C equal to the obſerved angle A S C, and B C D equal to the complement to 180 degrees of both the obſerved angles in D S B; thereby the point D is determined, thro' which, and the points C, B, the circle is to be deſcribed; and joining D A, produced, if needful, where it interſects the circle, as at S, is the place of ſtation ſought. This problem may be uſeful in determining the ſituation of ſands and rocks, within ſight of three places on land, whoſe diſtances are well known; or for chorographical uſes, &c. eſpecially, now there is a method of obſerving angles accurately by a teleſcope.

The Tin-Mines *in* Devonſhire *and* Cornwall. Phil. Tranſ. N° 69. p. 2096.

MINERS ſuppoſe that there was a great concuſſion of the waters, in that ſeparation of the waters from the waters at the creation, or at *Noah*'s flood, or at both theſe times, by which the ſurface of the then earth was removed; that till then, the uppermoſt *Loads* or veins did in moſt places lie even with the then real, but now imaginary ſurface of the earth, termed the *Shelf*, or *faſt Country*, or ground that was never moved by the flood; that in this concuſſion of the waters, the ſurface of the earth, together with the uppermoſt of theſe mineral veins were looſened and torn off, and by the deſcent of the waters into the valleys, both the *Grewt* or earth; and thoſe mineral ſtones or fragments thus torn off, called

Shoad, were by the force of the waters carried beneath their proper places, and from ſome hills to the bottoms of the neighbouring vallies, and thence, by land-floods, many miles down rivers: Upon theſe ſuppoſitions, they proceed in *training a Load*, or tracing a vein of ore; thus, where any mine is ſuſpected to be, they diligently ſearch that hill and country, that they may the better know the *Grewt* or earth, and the ſtones, when they are met with at a diſtance in the neighbouring valley, for mineral ſtones may be found at five miles diſtance from their *Loads*: Then they carefully obſerve the frets made in the banks of rivers by any great land-flood, if haply they can diſcover any metalline ſtones in their ſides and bottoms, together with the *Caſt of the Country*, that is any earth of a different colour from the reſt of the bank, which is a great help to direct them, which ſide or hill to ſearch into: And mineral ſtones are diſcovered, either by their ponderouſneſs, or poroſity, for moſt tin-ſtones are porous, not unlike great bones half calcined; yet tin ſometimes lies in the firmeſt ſtones: The third way is by water, termed *Vauning*, which is done by pulverizing the ſtone or clay, or what elſe may be ſuſpected to contain any mineral body, and placing it on a *Vauning-ſhovel*, the gravel remains in the hinder part, and the metal at the point of the ſhovel, by which, the kind, nature and quantity of the ore is gueſſed at: If no *Shoad* or tin-ſtones be found in theſe frets, they truſt not to any found in the river, it being uncertain whence the water may have brought them, eſpecially if they are ſmooth, and without aſperities, ſuch as are uſual in ſtones newly broken off; then they repair to the ſides of thoſe hills moſt ſuſpected to contain *Loads*, where a little ſtream of water may be conveniently conveyed in a *Leat*, *Gurt*, or trench, about two foot over, and as deep as the ſhelf, in which the water runs for two or three days, and in that time the *Shoad* is eaſily diſcovered, the water waſhing away the filth and looſer parts of the earth from the ſtone; if they find any, they may be aſſured of a *Load*, or at leaſt a *Squat*, in the upper parts of the hill; *Squats* are certain diſtinct places in the earth, not running in veins, differing from *Bonneys*, in this only, that *Squats* are flat, *Bonneys*, roundiſh: Sometimes *Shoad* may be found on the open ſurface of the ground, thrown up by the moles, or turned up by the plough; for by the corruption of vegetables and animals, ſince the deluge, the earth has got a new coat, a foot or more above the ſhelf, and this is plainly ſeen by the eye in every tin-work:

After

After trying all theſe ways, and no *Shoad* be found, they muſt proceed by gueſs, and at the foot or bottom of the hill they ſink an *Eſſay-hatch*, or a hole about ſix foot long, and four foot broad, as deep as the ſhelf; if they find no *Shoad* before, or when they come to the ſhelf, there is none to be expected; yet ſometimes the *Shoad* is waſhed away clean, when they come within two or three foot of the *Load*, and then the *Load* is a foot or two farther up in the hill; and it is an infallible rule, that the nigher the *Shoad* lies to the ſhelf, the nearer the load is, and on the contrary; if no *Shoad* be found in this firſt *Hatch*, they commonly aſcend about 12 fathom, and ſink a ſecond *Hatch* like the former; and in caſe, none appear in this, they go as many fathoms on each hand at the ſame height, and ſink there, and ſo aſcend proportionably with three or more *Hatches* a-breaſt, till they reach the top of the hill; and if none are found in any of theſe *Hatches*, they give over *training* in that hill. But if any *Shoad* be found in any of theſe *Hatches*, they keep their aſcending *Hatches* in a direct line; and as they approach the *Load*, they leſſen their firſt proportion of 12 fathom, to ſix or fewer: Sometimes they may over-ſhoot a *Load*, that is, get the upper ſide of it, and ſo loſe it; and then they ſink nigher that *Hatch*, wherein the laſt *Shoad* was found: Sometimes, they find two different *Shoads* in the ſame *Hatch* at different depths, then they are aſſured that there is another *Load* above the former, and in training up to the ſecond, they may meet with the *Shoad* of a third; and ſome tinners obſerve, that ſeven *Load* may lie parallel to each other in the ſame hill, and only one *Maſter-load*, the other ſix, three of each ſide, being the leſſer concomitants; ſo five may lie in like manner, and three are common: Every *Load* has a peculiar coloured earth or *Grewt*, about it, which is alſo found with the *Shoad*, and that in greater quantity, the nearer the *Shoad* lies to the *Load*, and ſo gradually leſſens to about a quarter of a mile's diſtance, beyond which, that peculiar *Grewt* is never found with the *Shoad*: A valley may happen to lie at the feet of three ſeveral hills, and then they may find three ſeveral *Deads*, *i. e.* common earth, or that looſe earth moved with the *Shoad* in the concuſſion, but not contiguous to the *Load* in its firſt poſition, termed alſo the *Run of the Country*, with as many different *Shoads* in the middle of each; and here the knowledge of the *Caſt of the Country*, or each hill, in reſpect of its *Grewt*, will be very neceſſary, for the ſurer training of them, one after the other, as they lie in order, according to the pre-

 ceding

ceeding rules of *Essay-hatches*, for the uppermost will direct you, with which hill to begin first: It may happen, that after they have trained up the hill, instead of a *Load*, they may only find a *Bonney* or *Squat*, which likewise have their *Shoad*, about two or three fathom long, and half as broad; few larger, most of them less; these *Bonneys* or *Squats* communicate with no other *Load* or vein, neither do they send forth any of their own, being distinct of themselves, without running out into innumerable strings, and they may sink into the *Shelf* five or six fathom and there terminate; these *Squats* are wrought with good advantage, nor is their tin of the worst sort.

The art and manner of digging up the ore is easy in respect of training; for, when they have found the *Load*, the last *Essay-hatch* is then termed a *Tin-shaft*, or *Tin-hatch*, which they sink down about a fathom, and then leave a little long square place, called a *Shamble*; and so continue sinking from cast to cast, that is, as high as a man can conveniently throw up the ore with a shovel, till they find either the *Load* grow small, or degenerate into some sort of weed, of which there are many, as *Mundic* or *Maxy*, a corruption of marcasite, white, yellow, and green; *Daze* a kind of glittering stone enduring the fire, white, black, and yellow; iron-mould, black and rusty; *Caul*, which is red, differing both from marcasite and spar, and enduring the fire; *Glister*, which is blood-red, and black: Then they begin to drive either east or west, as the goodness of the *Load*, or conveniency of the hill invite; and this they call a *Drift*, three foot over, and seven foot high for a man to stand upright and work in, and if the *Load* be not broad enough, as some are scarce half a foot, then they usually break down the *Deads*, or that part of the *Shelf* containing no metal, but enclosing the *Load* like a wall, and after that they begin to rip the *Load* itself: The instruments commonly used in mines for ripping the *Loads*, breaking the *Deads*, and landing both the ore and *Deads*, are 1. A *Beele* or *Cornish Tubber*, that is double pointed, of 8 or 10 pound weight, sharpened at both ends, well steeled, and bored in the middle; it may last in a hard country, half a year, but must be new pointed every fortnight at least. 2. A flat-headed *Sledge*, from 10 to 20 pound weight, which lasts above seven years, if new ordered once a quarter. 3. Four square *Gadds*, or wedges, of two pound weight, well steeled at the point, will last two or three days a-week, and then must be sharpened. 4. *Ladders*. 5. *Wheel-barrows*, for carrying the *Deads* and ore out of the

Drifts

Drifts or *Adits* to the *Shambles*: There are two ſhovel-men, and three beele-men which are as many, as one *Drift* can contain; the beele-men rip the *Deads* and ore; the ſhovel-men carry it off, and land it, by caſting it up with ſhovels, from one ſhamble to another; unleſs there be a *Winder* with two *Keebles*, which are great buckets like barrels with iron-hoops, one of which comes up as the other goes down: It is generally obſerved, that moſt of the tin-loads run from weſt to eaſt, and then they conſtantly dip towards the north; ſometimes, they *underlie*, that is, ſlope down towards the north, three foot in eight perpendicularly; which muſt be obſerved, in order to know where to ſink an air-ſhaft; yet in the higher mountains of *Dartmoor*, there are ſome conſiderable *Loads* which run north and ſouth, and theſe *underlie* towards the eaſt: Four or five *Loads* may run parallel to each other in the ſame hill, and yet, which is rare, meet together in one *Hatch*, as it were in a knot, which well tins the place; and ſo they ſeparate again, and keep their former diſtances; ſuch a knot was wrought on *Kingſton*, a known mineral-down or common in *Cornwall*: The breadth of *Maſter-loads* may generally be from three to ſeven foot broad, ſeldom larger, unleſs in ſome places, or where ſeveral *Loads* may chance to make a knot, or ſend forth ſtrings or veins; neither do they retain their uſual breadth in all parts; for they may be ſix foot in one place, and not two in another, nay, ſometimes, ſcarce half an inch over; but that is to be underſtood of ſtrings and the narroweſt places of the concomitant ones: The *Load* is uſually in a hard rocky country, made up of metal, ſpars and other weeds, and as it were all along a continued rock, with many veins and joints, as they call them; but in ſome ſofter countries, the tin may lie in a ſofter conſiſtence, as in clay in a manner petrified: In moſt places they meet with water, at the depth of ſome feet from the *Loady* ſurface; in other places, not at the depth of ſeveral fathoms; it runs commonly thro' the heart of the *Load*: When they find the water begin to annoy them, they deſcend to the bottom of the hill, and begin there a *Drift* or adit, ſcarce half ſo big as that of the *Load*, and work it on a level, till they come up to the *Load*; but if they have not the conveniency of an adit, or if they paſs the level of one that is made, they are forced to draw the water up with a *Winder* and *Keebles*, or leathern-bags, pumps or buckets to the level of the adit: It is obſerved, that if they have water, they never want air, either for breathing, or for their candles to burn; yet ſometimes in a ſoft clayey country,

country, the air is ſo much condenſed, that it becomes, in a manner, a damp, and requires an air-ſhaft for vent; which damps are ſometimes encreaſed by working the *Mundic* with the ore: If the country be not ſtrong enough to ſupport its own weight, they underprop the *Drifts* with *Stemples* or *Wall-plates*, placed much like a carpenter's ſquare, on the one ſide and over head: In order to know the courſe of the load, to bring an adit, or ſink an air-ſhaft, the uſe of the dial is needful, termed *Plumming* and *Dialling*, and is thus performed; a ſkilful perſon firſt faſtens the end of a long line at a known place, and then exactly obſerves the point at which the needle of his dial, or compaſs reſts, and at the next flexure in the adit makes a mark on his line, by a knot, or otherwiſe, and ſets his dial down again, and there likewiſe notes down that point at which the needle ſtands at the ſecond ſtation; and thus he proceeds from one turning to another, ſtill marking down the points, and making knots on his line, till he comes to the intended place; he then repeats above ground, what he had done below, and his dial and line direct him, till he comes exactly over the place where he ended in the mine.

The manner of dreſſing tin is this, after the ore is landed, and the greater ſtones broken at the top of the mine by the ſhovel-men, it is brought on horſes to the ſtamping or knocking mills, and unloaded at the head of the *Paſs*, that is, two or three bottom-boards with two ſide boards ſlope-wiſe, in which the ore ſlides down into the coffer, which is a long ſquare box, of the firmeſt timber, three foot long, and 1 ½ over; but to prevent the ore's tumbling down all at once, there is a *Hatch* near the lower end of the *Paſs*, that is, a croſs board to keep up the ore; beneath that comes in the cock-water in a trough cut in a long pole, which, together with the ore, falls down into the coffer, in which, the three uſual lifters, placed between two ſtrong broad *Lones*, with two braces, or croſs-pieces on each ſide to keep them ſteady, like a frame, with *Stamper-heads* of iron, weighing about 30 or 40 pound a-piece, ſerve to break the ore in the coffer; theſe *Lifters* are about eight foot long, and ½ foot ſquare of heart of oak, with as many in-timbers or guiders between them, and are raiſed up in order by double the number of *Tappets*, faſtened to as many *Arms*, paſſing diametrically thro' a great beam, turned by an over-ſhot water-wheel, on two boulſters, which *Tappets* exactly and with eaſe meet with the tongues, ſo placed in the *Lifters*, as that they quickly ſlide from each other, ſuffering the *Lifters* to fall with

great

great force on the ore, thereby breaking it into ſmall ſand, which is waſhed out by the cock-water thro' a braſs grate, with many holes, and placed within two iron bars, at one end of the coffer, into the *Launder*, a trench cut in the floor, eight foot long, and ten foot over, ſtopt at the other end with a turf, ſo that the waters run away, and the ore ſinks to the bottom, which, when full, is taken up and emptied with a ſhovel: The *Stamping-mill* is thus contrived to go two hours or more, after they give over attendance on it, there is a *Tiller* faſtened without at one end to the *Slew* or *Ponder*, *i. e.* the looſe and extreme part of the trough that conveys the ſtream to the mill-wheel; and at the other end is tied a ſhort rope, with a croſs ſtick at its extremity, hitch'd trap-wiſe at both ends under two little pins, faſtened in the *Lones* for that purpoſe; there is another pin ſet in one of the *Lifters*, at ſuch an exact height, that if there be no ore in the coffer to keep that *Lifter* high enough, the pin in deſcending knocks out the water, and carries it quite over the mill-wheel; ſo that when the coffer is emptied, the mill ſtops of itſelf: The *Launder* is divided into three parts, the forehead, the middle, and the tail; the ore that lies in the forehead, that is, within 1 $\frac{1}{2}$ foot of the grate, is the beſt tin, and is taken up in a heap a-part, and the middle and tails in another heap, and accounted the worſt: The latter heap is thrown out by the *Trambling-buddle*, which is a long ſquare tie of boards or ſlate, about four foot deep, ſix long, and three over, in which a man ſtands bare-footed with a *Trambling-ſhovel* in his hand to caſt up the ore, about an inch thick, on a long ſquare board juſt before him, and as high as his waſte, called the *Buddle-head*, and with the edge of his ſhovel he cuts and divides it length-wiſe about $\frac{1}{2}$ inch aſunder, and in theſe diviſions the water coming gently from the edge of an upper plain board, carries firſt away the filth and lighter part of the prepared ore, and then the tin immediately after, all falling down into the *Buddle*, where, with his bare feet, he ſtroaks and ſmooths it a-croſs, that the water and other heterogeneous matter may without any lett paſs away the quicker: When this *Buddle* is full, it is taken up, here again diſtinguiſhing the forehead from the middle and tails, which are *trambled* or waſhed over again; but the forehead of this, together with the forehead of the *Launder*, are *trambled* in a ſecond *Buddle*; and the forehead of this, being likewiſe ſeparated from the two other parts, is carried to a third, but *Drawing-buddle*, which differs from the reſt only in this, that it has no tie, but only a plain

plain ſloping-board, on which it is once more waſhed with the *Trambling-ſhovel*, and the ore is then named *Black-tin*, *i. e.* ſuch as is completely ready for the *Blowing-houſe*: There is another way more curious, termed *Sizing*, inſtead of a *Drawing-Buddle* they uſe a hair-ſieve, with which they ſift it, throwing what remains in the ſieve into the tails, and then that ore is new *trambled*; after the ſecond *trambling*, the forehead in the ſecond *Buddle* is taken, and *dilved*, that is, ſhaken in a canvas-ſieve in a large tub of water, ſo that the filth runs over the rim of the ſieve, leaving the *Black-tin* behind, which is put up into hogſheads, that are covered and locked till the next blowing: The tails of both *Buddles*, after two or three *tramblings*, are caſt out into the firſt *Strake* or *Tye*, which is a pit made expreſly to receive them, together with what over-ſmall tin may elſe waſh away in *Trambling*; there are commonly three or four, one after another, containing two ſorts of tin, the one, which is too ſmall, and the other, which is too great, and this latter is new-ground in a *Craze-mill*, every way reſembling a *Griſt-mill* with two ſtones, the upper and the nether, and after that it is *trambled*; the former, by reaſon of its exceeding ſmallneſs, is dreſſed on a *Reck*, a frame made of boards about 3 $\frac{1}{2}$ foot broad and 6 long, which turns upon two iron pegs, inſerted into two poſts at both ends, and may, like a *Cradle*, be eaſily moved either way, with the ſhovel and water.

The manner of blowing tin.——— The tin-kiln is four ſquare, and at the top is a large *Moor* ſtone, about 6 foot long and four broad, in the middle is a hole about $\frac{1}{2}$ foot diameter; this ſtone ſerves for a head or cover to another like it, and placed about a foot beneath it, but not ſo long by half a foot as the upper, becauſe it muſt not reach the innermoſt or back part of the wall, which is the aperture for the aſcent of the flame from a ſmaller place below, where a ſtrong fire of furze is conſtantly made; the fore-part is like a common oven: When they perceive much *Mundic* in their tin, which ſpoils it by making it brittle and hard, and not malleable, they burn away this weed in the kiln after the following manner; when the kiln is thoroughly heated, the *Black-tin* to be burnt is laid on the top-ſtone, and is caſt down at the ſquare hole upon the ſecond or bottom ſtone, as much as will cover it all over about three or four inches thick; then the hole at the top is immediately covered with green turf, that the flame may reverberate the ſtronger; and a rake-man with an iron coal-rake conſtantly ſpreads and moves the tin, that the *Mundic* may be uppermoſt,

moſt, and ſo burned away, which is infallibly known to be done by the yellow flame, and by the diminution of the ſtench, for while the *Mundic* burns the flame is exceeding blue; after that, it is thrown down with the rake, at the aperture behind, into the open fire, being ſucceeded by a new ſupply of tin from above; now when the fire-place becomes full of tin, coals, and aſhes, they are all raked out at a little ſquare hole on one ſide, near the back, where the ore, fiery hot and red, lies in the open air to cool, for which it will take three days, becauſe of the coals that lie hid in it; but in caſe they cannot wait ſo long, then it is quenched with water, and it becomes like mortar; and it muſt be new *trambled* or waſhed before it is put into the furnace, which is no other than an *Alman Furnace*. *Moor-tin*, ſuch as is dug up in *Moors*, runs or melts beſt with *Moor-coal*, charked; but the tin which lies in the country, runs beſt with an equal proportion of charcoal and peat, or *Moor-coal*, for the firſt running; but when the ſlags are re-melted, then charcoal is uſed: When all is melted down and re-melted, there ſometimes remains a different ſlag in the bottom of the float, termed *Mount-egg*, which is generally an iron body, tho' of a tin colour, as appears by applying one of the poles of a load-ſtone to it.

Of the Bleeding of Trees, *and the Circulation of the* Sap; *by Dr.* Liſter. Phil. Tranſ. N° 70. p. 2119.

FEB. 1ſt, it was froſt, and the wind at north, which continued to the 7th in the morning, when the wind came about to the ſouth-eaſt, and the weather broke up apace, yet the ſycamores did not bleed all this while, till the 7th about noon, when they bled very freely, both at the twigs and body; at the ſame time he ſtruck the hawthorn, hazel, wild-roſe, gooſeberry-buſh, apple-tree, cherry-tree, blather-nut, apricock, cherry-laurel, vine, walnut, yet none of them bled except the laſt, and that but faintly, in compariſon of the ſycamore. In all the monuments of antiquity, collected with ſo great induſtry by *Pliny*, few inſtances of this kind are to be found; and among theſe few is one, recorded with two or three remarkable circumſtances; for he tells us, that the ancient phyſicians, when they had a mind to draw the juice of the mulberry-tree, were wont to ſtrike it only ſkin-deep, and that about two hours after ſun-riſing; this experiment he repeats twice over as a ſurpriſing phænomenon; *lib.* 16. *cap.* 38. *mirum, hic (cortex) in moro, medicis ſuccum quærentibus, fere horâ diei ſecundâ, lapide*

pide incuſſus manat, altius fractus, ſiccus videtur. Lib. 23. c. 7. *Mora in Ægypto & Cypro ſui generis, ut diximus, largo ſucco abundant, ſummo cortice deſquamato; altiore plagâ ſiccantur, mirabili naturâ*; it is ſurpriſing, ſays he, that the bark of the mulberry-tree, when phyſicians would have its juice, ſhould, upon its being ſtruck with a ſtone, and two hours after ſun-riſing, run, and that, by ſtriking deeper, it ſhould not give one drop: Again, there are, as we ſaid, peculiar mulberry-trees in *Egypt* and *Cyprus*, which, upon peeling off the outmoſt coat of the bark, yield a plentiful juice, but, by a deeper wound, become quite dry, this is ſomething extraordinary. The weather changing from a white froſt, the following experiments were made on the ſycamore, walnut and maple; a twig cut aſunder would bleed very freely from that part remaining to the tree; and the ſeparated part would be entirely dry, tho' held with the cut extremity downwards, and a-ſlope; but if it was never ſo little tipt with a knife at the other end, in that poſition it would immediately be moiſt at both extremities; but held perpendicularly it would bleed without tipping: A twig cut off late in the afternoon, the weather being warm, would diſcover no moiſture from any part; and theſe experiments were repeated ſeveral times with the ſame ſucceſs on all the aforeſaid trees.

Poles of maple, ſycamore, and walnut cut down in open weather, and brought within the warmth of the fire, did bleed in an inſtant; alſo willow, hazel, cherry, wood-bine, blather-nut, vine, elder, barberry, apple-tree, ivy, &c. Briar and raſpberry were more obſtinate; aſh utterly refuſed, tho' heated; branches, that is, poles with their tops uncut, bleed alſo when brought to the fire; but ſeem not ſo freely to drink up their ſap again, when inverted, as when made poles; the ſame willow-poles left all night in the graſs-plot, and brought next day to the fire, bled a-freſh: A hard ligature made within a quarter of an inch of the end of a wood-bine rod did not hinder its bleeding, when brought within the warmth of the fire: Maple and willow poles, &c. quite bared of bark, and brought to the fire, will ſhew no moiſture in any part: A barberry or pipridge pole bared of its bark, and brought to the fire, diſcovered moiſture from the more internal circles, tho' not from the external: Maple and willow poles half bared of bark bleed by the fire, from that half of the circles under the remaining bark: Maple and willow poles, ſplit in two and planed, diſcovered moiſture on the extremities, but none on the planed ſides:

ſides: A pole of willow bent into a bow will bleed freely: If you ſeal up with wax one or both ends of the pith of a willow pole, it will notwithſtanding bleed freely by the warmth of the fire.

Dr. *Liſter* is of opinion, that there is a circulation of the ſap in trees; firſt, becauſe plants have veſſels analogous to thoſe in animals, as is very plain in ſuch plants, whoſe juice is either white, red, or ſaffron-coloured; ſecondly, becauſe there are many plants, and particularly lettice, wild-baſtard, ſaffron, and celandine, whoſe juice ſeems to be in continual motion, flowing at all times freely, like the blood of animals upon inciſion.

Of an early Swarm of Bees; *as alſo concerning* Cyder; *the Deſcent of* Sap; *and the Seaſon of tranſplanting* Vegetables; *by Mr.* Rich. Reed. Phil. Tranſ. N° 70. p. 2128.

MR. *Reed* obſerved a *Swarm of Bees* on the 9th of *March*, which is very uncommon, tho' that day happened to be very fair, for otherwiſe they never ſwarm till the middle of *May*; and this extraordinary inſtance might be owing to their poverty, which drew a part of them abroad to ſeek their fortunes, before their whole ſtock of proviſions ſhould be conſumed.

Mr. *Reed* recommends, for improving *Cyder* both in flavour and tincture, a new caſk, made of timber well ſeaſoned, for otherwiſe it may quite ſpoil it; he often tried it, and found that ſort of caſk to heighten the *Cyder*: The beſt *Cyder* he ever had was red-ſtreak grafted on a gennet-moyle-ſtock; for as thoſe kinds do beſt agree, and the trees ſo grafted do ſeldom canker, as the old red-ſtreak do on a crab-ſtock, ſo the fruit is far more delicate and mild, and when ripe, both rich, large, and good; and the *Cyder* is ſmoother, and is not ſo ſtrong and harſh, as that ingrafted on the crab, and requires leſs mellowing before making, the ſtock in ſome degree altering and correcting the nature of the fruit; for, as an apple, grafted on a crab, acquires an acrimony and ſpirit; ſo a crab, of which the red-ſtreak is a ſpecies, grafted on an apple, gains a certain mildneſs and ſoftneſs.

In order to prove that the ſap deſcends in winter, it has been obſerved, that the graft can either ſpoil or improve the ſtock, and even change the very nature and manner of the growth of the root in the earth, which muſt be owing to the deſcent of its ſap thither; and it has been found, that crab-ſtocks grafted with ſome ſorts of fruit in an unkindly ſoil, will all of

them canker, not only in the graft, but alſo in the ſtock; but if with a fruit to which the ſoil is kindly, they will all heal, and ſo become trees; and further, that if you graft 20 wild pear-ſtocks with the ſame ſort of pear, and 20 with another, the roots of the former will each of them grow alike, and juſt ſo will be the caſe in the latter; this diverſity, in the manner of the growth of the root, muſt ariſe from the grafting, and conſequently from the deſcent of the ſap: And the knowledge of this circulation is very important; for if the ſap returns not, then trees may be pruned in any time of the year without loſs of ſap, which is their blood, and that wherein their life conſiſts.

Mr. *Reed* never began to plant till *Valentine*'s day, and he preferred late to early planting, and farther obſerved, that winter cold kills more than ſummer drought, tho' it is imputed to the drought, becauſe they languiſh till ſummer, and then die; but they receive the fatal ſtroke by the winter cold: Stocks are either taken from woods or nurſeries, and in either place they lie warm; if you therefore tranſplant them in *October*, they are all of a ſudden expoſed to an open air, and to a long, and perhaps, cold winter, which they are unable to bear; beſides, you may ſecure them againſt drought, by watering and covering the ground, to keep it cool; but there is no fence againſt froſt, which often gets into the roots, and kills them, ſo that they never ſpring; and if they do, yet poorly, and they die in the ſpring; or if they ſurvive, as many do, yet they come on very ſlowly; for cold dries up both wood and bark in ſuch a manner, that they cling together, and hinder the aſcent of the ſap from the root, which on that account runs out below into ſuckers, and the tree grows dry, and turns red; all which ſhew an obſtruction of the ſap; in which caſe, the bark muſt be looſened: Now, on the other hand, if the ſummer prove moiſt, the danger of late ſetting is over, and they will thrive and come forward apace; and if not, they always keep green and freſh, being maintained in life and verdure by the ſap they receive in the beginning of the ſpring, before they are tranſplanted: In tranſplanting, let the roots be preſerved and ſet as large as poſſible; for the larger the root, the ſtronger it is, and contains more ſap, and conſequently the growth of the tree is the more promoted; tho' ſome planters affirm, that roots cut ſhort ſucceed beſt, as ſending forth new roots, which draw ſap and nouriſhment well; and it is obſerved, that moyles ſet on ſlips that have no roots, come ſooner to a tree; and that a moyle tranſplanted after taking root, does not live ſo certainly, nor thrive ſo well, as a ſlip newly ſet.

Some Obſervations on Colours *and* Dyes; *by Dr.* Liſter. Phil. Tranſ. N° 70. p. 2132.

THERE are two things chiefly aimed at in the inquiry into *Colours*; the one, to encreaſe the *Materia tinctoria*, or number of dying materials, and the other to fix thoſe colours either already known or hereafter to be diſcovered: As to the firſt, animals and vegetables, beſides other natural bodies, may furniſh great plenty; and in both theſe kinds, ſome colours are apparent, as the ſeveral colours of flowers, the juices of fruits, *&c.* and the ſanies of animals; others are latent, and diſcovered by the effects, the ſeveral ſorts of ſalts and other things may have upon them: Mr. *Boyle* gives ſeveral inſtances of the apparent colours of vegetables and animals, and the various effects of different ſalts in changing them from one colour to another; acid ſalts heighten the colours of flowers and berries, that is, according to Mr. *Boyle*'s experiments, they make the infuſions of pomgranat-flowers, red-roſes, clove-gilly-flowers, meſerion, peaſe-bloom, violets, cyanus-flowers, of a fairer red, as alſo the juices of the berries of *Liguſtrum*, black cherries, buck-thorn berries; and acid ſalts make no great alterations on the white flowers of jeſſamin and ſnow-drops: Urinous ſalts and alcalies on the contrary, quite alter and change the colours of the above-mentioned flowers, and the juices of the ſaid berries from a red to a green, even jeſſamin and ſnow-drops: Again, urinous ſpirits and alcali's heighten, or at leaſt do not quite ſpoil the colours of the juices of leaves of vegetables, and of their wood and root; thus Mr. *Boyle* tells us, that urinous ſpirits and alcali's make the yellow infuſions of madder-roots red; of *Braſil* wood, purple; of *Lignum nephriticum*, blue; the red infuſion of log-wood, purple; of the leaves of ſenna, red; on the contrary, acid ſalts quite alter and change the ſaid infuſions from red or blue to yellow: The inſtances of colours in animals are very few, the purple-fiſh being quite out of uſe, and whether cochineel and kermes be animals or not, is a queſtion; however, upon the affuſion of oil of vitriol, which is an acid ſalt, on cochineel, it ſtrikes the moſt vivid crimſon that can be imagined; and with urinous ſalts and alcali's, it will be again changed into an obſcure colour between a violet and a purple. As to the apparent colours of flowers, it may be ſaid, that generally all red, blue, and white flowers are immediately, upon the affuſion of an alcali, changed into a green colour, and then in a little time turned yellow; that

that all the parts of vegetables, which are green, will in a like manner ſtrike a yellow with an alcali; that what flowers are already yellow, are not much changed, if at all, by an alcali or urinous ſpirit; the blue ſeed huſks of *Glaſtum Sylveſtre*, long gathered and dry, and diluted in water, ſtain a blue, which, upon the affuſion of lye, ſtrikes a green, and this green or blue being touched with the oil of vitriol dyes a purple; and all theſe three colours ſtand; on the tops of *Muſcus Tubuloſus*, ſo called by Mr. *Ray* in his catalogue of *Engliſh* plants, are certain red knots, which, on the affuſion of lye, will ſtrike a purple and ſtand.

The latent colours of vegetables and animals diſcoverable by the affuſion of ſalts, are doubtleſs very numerous, and as to the former, the milky juice of *Lactuca Sylveſtris coſtâ Spinosâ*, and *Sonchus Aſper* and *Lævis*, upon the affuſion of lye, will ſtrike a vivid flame-colour or crimſon, and after ſome time quite degenerate into a dirty yellow. The milk of *Cataputia Minor*, upon the affuſion of lye, eſpecially if drawn with a knife, and has ſtood any time on its blade, will ſtrike a purple or blood-red colour, and by and by change into a dirty yellow: As to latent animal dyes, the common hawthorn-caterpillar will ſtrike a purple, or carnation with lye, and ſtand; the heads of beetles and piſmires, *&c.* will ſtrike the ſame colour with lye, and ſtand; the amber coloured *Scolopendra* will with a lye give a moſt beautiful and agreeable azure, or amethyſtine, and be durable.

Among all the inſtances above-mentioned, whether vegetable or animal, there is not one colour truly fixt, that is, proof againſt ſalt and fire; for what ſeem to ſtand and be lye-proof, are either wholly deſtroyed by a different ſalt, or changed into a very different colour, which muſt needs prove a ſtain and blemiſh, when it ſhall happen in any of them: Both the apparent and latent colours of vegetables are fixable, as appears from the ſeed-huſks of *Glaſtum* or *Woad*, and the uſe dyers make of the leaves after due preparation: From the ſame inſtance it is probable, we may learn from the colour of ſome one part of the fruit or ſeed, what colour the leaves of any vegetable and the whole plant might be made to yield for our uſe: The latent colours of vegetables are pre-exiſtent, and not produced, as appears from the ſame inſtance of *Woad*, and alſo from the milky juice of *Lactuca Sylveſtris* or wild lettuce, which affords a red ſerum: The change of colours in flowers is gradual and conſtant: The colours of flowers, that

are

are not lye-proof, ſeem to be wholly deſtroyed by it, and that irrecoverably; thus it happens in the experiment, wherein a part of a violet leaf, upon the affuſion of lye, is ſoon changed into yellow, which will never by any acid ſalt be revived into a red, but if another part of the ſame leaf be ſtill green, it will be revived: Their drineſs ſeems to be a means, if not of fixing, yet bringing the vegetable colour to a condition of not wholly and ſuddenly periſhing by *Alcali's*: Such plants or animals as will ſtrike different, yet vivid colours, upon the affuſion of different ſalts, and ſtand; as for inſtance, cochineel and *Glaſtum*, are probably of all others to be reckoned the beſt materials.

Obſervations in the Upper Egypt; *by* F. Brothais. Phil. Tranſ. N° 71. p. 2151.

THIS Father went up the *Nile* 300 leagues above *Cairo*, two days journey on this ſide of the *Caſcades*, where he obſerved ſeveral idol-temples ſtill entire, together with very ancient palaces filled with ſtatues and idols; in one place he reckoned ſeven obeliſks like thoſe at *Rome*, and about 120 columns in one hall, and from top to bottom inſcribed with hieroglyphic characters, and figures of falſe deities: He found ſtatues of white marble, of a hard ſtone, of the bigneſs of three ordinary perſons, with a ſword on their ſide, *viz.* a man and a woman, and of the height at leaſt of eight fathoms, tho' ſeated in chairs, and well proportioned; and two others of black marble repreſenting women, with globes on their heads, and extravagant coverings thereon, which were two foot broad from one ſhoulder to the other: He lighted on two places where antiquities were to be ſeen, the one called *Lozor*, and the other *Candion*, which is a very ancient caſtle, eſteemed by the tradition of the country to have formerly been the reſidence of a king; in the avenues are a great number of ſphinx's ſtanding in a row and turning their heads towards the alleys, it is known that this figure is an idol, with the head of a woman, and the body of a lyon, which was once a famous deity among the *Egyptians*; their diſtance from each other is about two paces, and they are 20 foot long; he reckoned 60 of them on one ſide of an alley, and as many on the other ſide, and 51 in another alley, all well proportioned; theſe alleys are of the largeneſs of a palmal; the gates of the caſtle are extraordinary high, covered with excellent ſtone, meaſuring one of which, he found it 26 ½ foot long, and proportionably thick;

thick; there are above a million of figures in profile engraven on the walls and pillars; that which moſt pleaſed him was the ground, where the azure and the other colours, which are like enamel, appear as freſh as if they had been laid on but a month before: There are temples ſo ſpacious, that 3000 people may ſtand on the roof with eaſe; in the ſame caſtle is a pond, whoſe water is bitter, ſet about with fine ſtone; this water is ſaid to whiten linnen perfectly without any thing elſe, and upon dipping his handkerchief in it, it retained the ſcent of ſoap for four or five days. There are a great number of chriſtian *Cophts* in this country, who have many monaſteries and ancient churches, but poor.

The irregular Flux *and* Reflux *of the* Euripus; *by* F. Jac. Paul Babin. Phil. Tranſ. N° 71. p. 2153.

THE *Euripus* is a *Straight* of the *Ægean* ſea, ſo narrow that a galley can ſcarce paſs thro' it, under a bridge, built between the citadel, and the *Donjon* of *Negropont*; and not only the place where the bridge is, is called the *Euripus*, but it alſo retains that name for 10 or 12 leagues on each ſide of it, where the channel being larger, the inconſtancy of its tides is not ſo ſenſible, as at the foot of the caſtle: For three or four leagues on each ſide are found ſix or ſeven gulfs, wherein this water ſhuts itſelf up, to iſſue thence as often as it enters there, and the ſituation of theſe gulfs contributes to the oddneſs of this flux and reflux, of which the moon ſeems to be the principal cauſe: There are 20 days of each moon, in which the courſe of the *Euripus* is regular, and ten, in which it is irregular, that is, five days before and five days after the new and full-moon, its courſe is irregular and ſtrong; and after that, the ſame phænomena are ſeen there as in the ocean at *Bourdeaux*, the ſea has two fluxes and refluxes in 24 hours, and every day later by almoſt an hour; but there are nine or ten changes of the courſe of the water during the remaining ten days of inequality, unleſs it blow hard, for then the courſe changes not above ſix or ſeven times: He once obſerved the courſe of the water change thrice, tho' the wind was pretty high, and the wheels of a mill turned as often different ways: The water riſes not above a foot; and when it riſes it runs into the ocean, and when it ſinks it flows into the channel, going up towards *Conſtantinople*: The ſmall gulfs, that are on the left ſide of the port of *Negropont*, are filled when the water riſes, and emptied, when it deſcends, running towards

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Thessalonica or *Constantinople*; F. *Vabois* observed the same thing at the latter place, *viz.* that the waters of the black sea, that come from *Constantinople* drive the *Euripus* in its rising towards the main sea, and that afterwards the waters retire towards the same place from whence they came; the same person also observed that the swelling of the *Euripus*, which is irregular, lasted not above a quarter of an hour, and its sinking three quarters, tho' then the water ran with greater rapidity and seemed to retire in thrice the quantity it rose with: Between the rising and falling there is a little interval, wherein the water seems to be at rest and stagnating, so that, if there be no wind stirring, bits of wood and straw lie still upon the water without motion: From what has been said, it is easy to reconcile the authors, that have written so differently of the *Euripus*; for such as mention two fluxes and refluxes in 24 hours, as in the ocean, have only observed it in the 20 days of its regularity; and the ancients have not delivered a falshood, when they say, that there are seven reciprocations in one day, because that happens, when the winds trouble and retard the course of the water; and F. *Babin* assures us from repeated observations, that when it is still weather, the flux or reflux is made even to nine or ten times in a natural day.

Hurricanes *and* Storms; *by* Mr. Templer. Phil. Transf. N° 71. p. 2156.

OCTOB. 30. 1669 between five and six o'clock in the afternoon the wind being westerly, there happened at *Ashley* in *Northamptonshire* a dreadful hurricane, scarce being 60 yards in its breadth, and spending itself in about seven minutes of time; its first assault was on a milk maid, taking her hat from off her head, and carrying her pail many yards, where it lay undiscovered some days; next it stormed the yard of one *Sprigg* dwelling in *Westthorp*, where it blew a waggon-body off the axle-trees, breaking the wheel and axle-trees in pieces, and blowing three of the wheels so shattered over a wall; this waggon stood somewhat cross to the course of the wind: Another waggon of Mr. *Salisbury* was driven with great force against the side of his house; a branch of an ash-tree, which two sturdy men could scarce lift, was torn off from a tree at 100 yards distance and blown over his house; a slate, that must have come the distance of 200 yards, none being nearer, struck against an iron bar in a window and bent it very much: At Mr. *Maidwel's* it forced open a door, breaking the

latch, and forcing open the dairy-door, it overturned the milk-pails, and ſtruck out three panes in the window, and in the chambers nine panes more; it tore off a great deal of the roof of the parſonage houſe, and rooted up a gate-poſt 2 ½ foot deep in the earth, and carried it many yards off; it blew a large hovel of peaſe from its ſupporters, and ſet it upon the ground, without any conſiderable damage to the thatch: About ½ mile from the town is a ſmall wood on the top of a hill, which partly deſcends into a vale encompaſſed with hills to the north and ſouth; ſo that the wind may ſeem confined to the vale, as a channel, before it aſſaulted the town, and ſo be forced to ſpend itſelf only in that glade; yet ſome blaſts from the aſcending wood-ground might contribute to this accident, becauſe the wind continued, as far as could be judged, as high in the field afterwards, and the ſituation of the town did expoſe a far greater part of it to this damage than was really affected, the valley being above four or five times the breadth of that part of the town concerned in it.

Octob. 1670, at *Braybrook* in *Northamptonſhire*, about 11 o'clock, the ſtorm attacked a peaſe-reek in the field, uncovered its thatch, without touching another within 20 yards of it; it blew up the end of a barley-reek, with ſome ſtakes in it near five foot long, without hurting a wheat-hovel within ſix yards of the barley-reek; it afterwards uncovered the parſonage houſe; from whence it paſſed over the town, without doing any damage, its ſituation being low; at *Fort-hill* it uncovered as much of a malt-houſe as lay within its extent and breadth: *Braybrook* ſtands in a valley ſurrounded with hills on three ſides, at the diſtance of ¾ mile; there is a hill called *Clack-hill* within a mile of it, and exactly in that point of the compaſs in which the wind then ſtood; and which is remarkable, there have been two earthquakes in this town within theſe 10 years, when the wind or rather gentle air then only vibrated on that point of the compaſs,

Of Stones *in Human* Bodies; *by* Mr. Chriſt. Kirkby. Phil. Tranſ. N° 71. p. 2158.

A Woman near *Dantzick*, of 56 years of age, and unmarried, whoſe whole courſe of life had been extremely ſedentary, was troubled, ſome years before her death, with great pains in her back, eſpecially towards the right ſide, and with a continual retching; her urine for ſome time before was turbid, and ſeemed mixt with blood, yet entirely void of ſalt:

When

When ſhe was opened, the left kidney was found full of large ſtones, but the right was entirely petrified, covered with the ordinary ſkin without any fleſh; it was both maſſy and ponderous, and concreted by the cloſe coalition of minute ſand, which might be rubbed off by the finger.

The other inſtance is a lad about 19 years of age, who from his cradle was diſpoſed to a conſumption, accompanied with continual coughing, great emaciation and heat, ſo that at laſt, after being reduced to a ſkeleton, he died: Being opened, a great deal of watry matter, of a chylous conſiſtence, run out of the *Abdomen*; almoſt all the glands of the meſentery, thro' which the lacteals paſs, were very large and hardened beyond the hardneſs of a ſcirrhus: Upon opening the breaſt, the lungs were found adhering to it all round, ſo as ſcarcely to be ſeparated, and full of purulent ulcers, but more eſpecially the left ſide, which was full of gravel and ſmall ſtones; and even entire pieces of the lungs, eſpecially the extremities, for about the thickneſs of a finger and more, were hardened into a ſtony ſubſtance.

Obſervations on certain Inſect-huſks *of the* Kermes-kind; *by* Dr. Liſter. Phil. Tranſ. N° 71. p. 2165.

DR. *Liſter* has gathered off the *Engliſh* oak round worm-huſks very like kermes berries; and he often obſerved on plumb-trees and cherry, as alſo on the vine and cherry-laurel, certain *Patellæ* or flat huſks containing worms, which, or at leaſt the huſks, will ſtrike a carnation with lye and continue afterwards; he obſerved the ſame *Patellæ* or huſks indifferently on vine-branches, cherry-laurel, roſe-buſhes, plumb-trees and the cherry-tree; the figure of the huſk is round, ſave where it cleaved to the branch, and a little bigger than half a grey pea; theſe cleave to their branches as *Patellæ* do to rocks; they are of a dark cheſnut colour, extremely ſmooth and ſhining like a membrane; they commonly adhere to the under-ſide of a branch or twig, and ſo are beſt ſecured againſt the injuries of the weather, as too much ſun and rain; they are well faſtened to the branches, ſometimes ſingle and ſometimes more together; they are ſeldom found without vermin, as piſmires, &c. which probably pierce and prey upon them; if you cut off dextrouſly the top of the huſk with a razor, you will ſometimes find five or more ſmall white maggots of the waſp or bee-kind, that is, ſharp at both ends; when theſe are carefully taken out, you may further obſerve what remains of

their provifion of meat, and a partition between them, and the branch, where their excrements are difcharged; and if, after clearing the hufk, you rub the empty membrane on white paper, it will freely and copioufly tinge it with a beautiful purple or murrey.

Of the Amianthus *found in fome* Mines *in* Italy. Phil. Tranf. N° 72. p. 2167.

SIGNOR *Marco Antonio Caftagna*, fuperintendant of fome mines in *Italy*, has found in one of them a great quantity of that downy ftone, called *Amianthus*, which he knows how to prepare in fuch a manner, as to render it fo tractable and foft, that it refembles a fine lamb-fkin dreffed white; he thickens and thins it to what degree he pleafes, fo that it becomes either like to a very white fkin, or a very white paper, both which refift the moft violent fire, as he has often experienced; the fkin was firft covered with burning coals, whence it took flame, but being taken out after it had been left there a while, the fiery colour prefently difappeared, and it became cold and white again as before; the fire, it feems, paffing only thro' without wafting or altering it in the leaft, whereas fome of the hardeft and moft folid metals, as iron and copper, reduced to very thin plates, and kept as long in the fire, as this fubftance was, would caft fcales: Again, this fkin being reduced to the thinnefs of paper, not only yields that ancient, and fo much admired *Amianthus*, but is alfo more perfect than that which comes from *Cyprus*, and not inferior to that from *China*; this paper was alfo tried in the fire, and there it remained without the leaft change of its firft whitenefs, finenefs or foftnefs; a wick was made of the fame matter, which is never confumed as long as it is fed, nor alters its quality after the fuel is wafted.

Of a Viviparous Fly; *by* Dr. Lifter. Phil. Tranf. N° 72. p. 2170.

THERE is a fly with grey and black ftreaks on the fhoulders, and chequered on the tail with the fame colours; upon opening the female of this fly, which may be diftinguifhed by a rednefs on the extremity of the tail, you will find two bags of live white worms, long and round in fhape, with black heads, moving both on the hand and in the un-opened veficles backwards and forwards, for they are difpofed in cells according to the length of the animals body; fome fuch thing is hinted by *Aldrovandus*. *Lib.* I. *de Infect.* p. 57.

A Musk-

A Musk-ſcented Inſect *feeding upon* Henbane. Phil. Tranſ. N° 72. p. 2176.

THERE is a *Cimex* of the largeſt ſize, of a red colour, ſpotted black, which is to be found frequently and in great numbers on henbane; this inſect in all probability feeds on this plant, by ſtriking its trunk, the note of diſtinction of this kind of inſect from the reſt of the beetle-kind, into the leaves, and extracting much of their ſubſtance, as other ſorts of *Cimex*'s will on the bodies of men: It is farther obſervable, that the ſtrong ſmell, with which the leaves of this plant affect the noſtrils, is very much qualified in this inſect, and in ſome meaſure aromatic and agreeable; and therefore we may expect that that benumming quality, ſo eminent in this plant, may likewiſe be uſefully tempered in this inſect.

About the latter end of *May*, and ſooner you may find adhering to the upper ſide of the leaves of this plant, certain oblong, orange coloured eggs, which are thoſe of this inſect; theſe eggs in the belly of the female are white, and continue of that colour ſometime after they are laid; but as the time of their being hatched approaches, they acquire a deeper colour, and are hatched *Cimex*'s, and not in the diſguiſe of worms; if you cruſh the riper eggs upon white paper, they ſtain it without any addition of ſalt, with as lively a vermillion, as any other thing in nature, not excepting cochineel, aſſiſted with oil of vitriol.

Obſervations on the Glow-worm; *by* Mr. J. Templer. Phil. Tranſ. N° 72. p. 2177.

MAY 27, between 11 and 12 at night Mr. *Templer* put a glow worm into a ſmall thin box, ſuch as is uſed for pills, and it was obſerved to ſhine very clearly thro' the box; and again incloſing it in white paper, in the box, it ſhone thro' both: *May* 28, about eight o'clock in the morning it ſeemed dead, and holding it in a very dark place, very little light was perceivable, and that only when it was turned on its back, and conſequently put into ſome little motion; after ſun-ſet that night it walked briſkly up and down in the box, ſhining as bright as preceeding night, and that when there was ſo much day-light, that one could read without a candle: *May* 29, in the morning it ſeemed dead again, but recovered at night and ſhone as well as ever thro' the box, and opening the box and holding a large candle, its light did not ſenſibly diminiſh

diminiſh that of the glow-worm: *May* 30th, about ten at night, putting the box with the worm in a window, at the diſtance of four yards, it was perceived to ſhine thro' the box for almoſt an hour: *May* 31ſt, at five o'clock in the evening, the worm ſhone pretty clearly in a very lightſome room, in a bright ſun-ſhine; ſome time after, it ſhone but little, having contracted her body into a bending poſture, the light ſcarcely ſo big as a great pin's head; but by a touch it extended itſelf, walked in its box, and ſhone as bright as ever. Mr. *Temple* never obſerved it ſhine without ſome ſenſible motion, either in her body or legs; in its brighteſt ſhinings, it extended its body a third beyond its uſual length; and it ſeemed to emit a ſenſible light in her cleareſt ſhinings.

The Compreſſion of Air *under* Water. Phil. Tranſ. N° 73. p. 2192.

SOME members of the Royal Society, had with two different ſorts of inſtruments made ſeveral experiments for finding the proportions of the compreſſion of air under water, in *July* at *Sheerneſs* in the mouth of the river *Medway*, at high-water, being then about 19 fathoms deep, and the proportion of the weight of the ſalt-water to the ſame quantity of freſh taken out of the *Thames* was as 42 to 41: One of the inſtruments was a glaſs bottle, holding a quart of water, with a braſs ring faſtened to its mouth, and a valve opening internally, ſo well fitted, that with whatever quantity of water the bottle was filled, none dropped out tho' forcibly ſhaken; letting it down 33 foot into the water with the mouth downwards, and in a little time drawn up again, was found to be ſo very near half full of water, at ſeveral trials, that it was thought fit to ſtate the compreſſion of air at that depth to that meaſure, which at other depths was found to hold the proportions calculated for that purpoſe: The quantity of the compreſſion was known by weighing the bottle with the water in it, after a forcible depreſſion of the valve had made way for the eruption of the compreſſed air, which kept it up even when the bottle was placed with the mouth upwards, and then filling the bottle full of the ſame water, and weighing it again, and laſtly weighing the bottle after all the water was let out, and deducting its weight, the firſt quantity of water weighed juſt half as much as the ſecond, or ſo near it that the fraction was inconſiderable; whence it was concluded, that the quantity of air that filled the bottle before its immerſion into the water, was, at the depth of 33 foot

foot, compreſſed into half the ſpace it took up before, and ſo proportionably at other depths; this was confirmed by repeated experiments made with the other inſtruments; which was a cylinder of glaſs, about two foot long, cloſe at one end, and the other end drawn ſmall with a lamp, Pl. X. fi. 1. and turned down or bent a little; this cylinder was immerſed perpendicularly with the crooked end uppermoſt, by which, as it ſunk in the water, its preſſure did gradually force in ſo much water, as thruſt out the air in proportion to the depth, till the cylinder was ſo far immerſed, that the hole of its crooked pipe was juſt 33 foot under water, and then being drawn up, by meaſuring with a pair of compaſſes from the bottom of the cylinder to the hole in the crooked pipe, the water was found to fill the cylinder ſo near half full, that the motion of the ſurface of the water, which then was very ſmooth, and the minuteneſs of the difference being conſidered, it was thought fit to ſtate it to juſt half; according to which, and experiments at other depths, a table was calculated: The proportion of the weight of ſalt-water to that of freſh, was found by weighing ſome ounces of both in a bottle, whoſe weight was exactly known, and with ſo ſmall a neck, that the addition or deduction of one ſingle drop was diſcernible: The table was computed on the ſuppoſed perpendicular immerſion of a cylinder of 60 inches, ſhut at one end, and with the open end downwards. Theſe experiments are not matter of mere ſpeculation, but are uſeful for divers, becauſe it may be previouſly known, at what depth when they ſink in the diving-bell, or other fit machines, they may bear the additional denſity of the compreſſed air, to enable them to reſpire ſomewhat freely; as alſo, how they may furniſh themſelves with air in proper veſſels variouſly adapted for that purpoſe. The tabular calculation whereof we ſhall hereafter inſert, when Dr. *Halley*'s method of diving by the bell comes under conſideration; which will ſhew both the theory and practice, and thereby render it more clear and conſpicuous in explaining advantageouſly the baſis of that invention.

The Inſect-huſks *of the* Kermes-kind, *and their Uſe in* Dying; *by Dr.* Liſter. Phil. Tranſ. N° 73. p. 2196.

DR. *Liſter* found ſeveral of the *Patellæ Kermi-formes* hatched in a box, wherein they were deſignedly put, and they proved a ſpecies of bees, but very ſmall, not much exceeding in bulk half a piſmire; they are very compact and thick for their bigneſs, and of a coal-black colour; they ſeem to

to want neither ſting, nor the three balls in a triangle in their forehead; what is very remarkable, is a white large and round ſpot on the back; the upper pair of their four wings is ſhaded, with dark ſpots; the undermoſt pair is clear.

It is to be obſerved, that the blackeſt huſks yield the deepeſt and beſt purple; that as the bees come to maturity the dye ſeems to be ſpent, and the huſks grow dry; that the young make their way at ſeveral little holes; whereas the true kermes-huſk ſeems to be pierced but in one place.

Upon comparing the *Engliſh* purple-kermes with the ſcarlet-kermes, or grains of the ſhops, they were found to agree in every thing, ſave the colour of their juices; and in the grains of the ſhops, many were found ſticking to little twigs of the *Ilex* or oak, ſo that they, as well as the *Engliſh*, are only contiguous to the branches, and not excreſcences of the tree, much leſs fruits or berries; but that they are the ſole work of the parent-bee for the more convenient lodging and nouriſhment of her young.

Further Obſervations on the new Star *near the Beak of* Cygnus; *by* M. Hevelius. Phil. Tranſ. N° 73. p. 2197. Tranſlated from the *Latin*.

M. *Hevelius* had again, *April* 29th, 1671, obſerved the new ſtar below the head of *Cygnus*, and in the ſame place, *viz.* near the *Milky Way*, where he ſaw it the preceeding year from *June* and *July* to the 14th of *October*; and that it appeared bigger then, exceeding the ſtar in the bill of *Cygnus*, as alſo that in the bend of its inferior wing, and being almoſt equal to the ſtar in the breaſt, ſave only that its light was duller and more ruddy: It was not ſeen in *December*, *January*, and *February*; for after the 14th of *October*, when it ceaſed to appear, it was ſought for in vain, and therefore it ſcarce diſcovered itſelf before the beginning of *March*, or poſſibly later; he had lately meaſured its diſtance from ſome fixt ſtars, and found it at 20°, 55′, 20″, from the tail of *Cygnus*; 17°, 47′, 50″, from the bend of the ſuperior wing; and 34°, 19′, 40″, from the head of *Serpentarius*.

Of the ſame Star. Phil. Tranſ. N° 73. p. 2198.

DOM *Anthelme*, a *Carthuſian* of *Dijon*, obſerved *June* 20th, 1670, near *Cygnus*, a new ſtar of the third magnitude, which he ſignifying to the company that aſſembled at the king's library, many of them agreed, that near the beak of *Cygnus* a new

new ſtar was to be ſeen, and not to be met with in any catalogue of aſtronomers, tho' many other neighbouring ſtars much ſmaller, be exactly marked by them; it was ſituated as in Plate X. Fig. 2. ſuppoſing the obliquity of the ecliptic be $23\frac{1}{2}°$; the longitude of this ſtar, according to the obſervation of M. *Picard* was 1° 55′ of *Aquarius*; the right aſcenſion 293° 33′; the north latitude 47° 28′, and the declination 26° 33′; it came to the meridian after the ſtar in the beak of *Cygnus* 16′ 44″, and before the lucid ſtar of the eagle 27″; it was diſtant from the great ſtar of *Lyra* 18° 39′ 40″; from the beak of *Cygnus* 3° 47′ 30″, and from the tail of *Cygnus* 20° 54′ 30″: What is further remarkable is, that in the beginning of *July*, this ſtar was obſerved to decreaſe; *July* 3d, it appeared yet of the third magnitude, but its light was ſenſibly fainter; *July* 11th, it ſcarce appeared of the fourth magnitude; *Auguſt* 10th, it was only of the fifth, and ever ſince it decreaſed, till it could no more be ſeen; and ſo has continued for ſix months without ſhewing itſelf till *March* 17th, when *Dom Anthelme* viewed it in the very ſame place it was the preceeding year, and found it of the fourth magnitude; the aſſembly that meets in the king's library having notice thereof, ſeveral of them obſerved this ſtar *April* 2d, finding it in the ſame place they had ſeen it the preceeding year; *April* 3d; M. *Caſſini* found it greater than the two ſtars of the third magnitude below *Lyra*, but a little ſmaller than that in the beak of *Cygnus*; *April* 4th, it appeared to him almoſt as big, and much more radiant than that in the beak of the ſwan; *April* 9th, he found it a little diminiſhed, and almoſt equal the greateſt of the two ſtars that are below in *Lyra*; *April* 12th, it was equal to the leaſt of theſe two ſtars; *April* 15th, he perceived it encreaſed, and found it equal the ſecond time to the greateſt of theſe two ſtars; from 16th to 27th it appeared of different magnitudes, ſometimes equal to the biggeſt of theſe two ſtars, ſometimes equal to the leaſt, and now and then of a mean magnitude; but 27th and 28th it was become as big as the ſtar in the ſwan's beak; 30th it appeared a little clearer; and the firſt ſix days in *May* it was bigger; *May* 15th, it was ſeen ſmaller than the ſame ſtar; 16th, it was of a mean bigneſs, between the two ſtars that are below in *Lyra*; and ever ſince it has been ſtill diminiſhing: Thus this ſtar has been twice in its greateſt ſplendor, firſt, on *April* 4th, and then in the beginning of *May*, a thing never obſerved in any other ſtar: As far as can be judged from the few obſervations

made on this ſtar, it is likely its return is in about 10 months; whereas that in the whale's neck makes its revolution in 11 months; as for the ſtar in the ſwan's breaſt, there is yet no certain knowledge of its period, and it may poſſibly take 14 years to finiſh its courſe: The diſcoveries that have been made in the heavens this laſt age, do evince that changes are not ſo rare there, as formerly was thought; if what *Pliny* ſays be true, that *Hipparchus*, on the occaſion of a new ſtar he obſerved, numbered all thoſe that appeared at that time, there would not be any one conſtellation, in which ſome change would not be found ſince that time, in regard there are few, in which there are not found more ſtars now than that aſtronomer has reckoned; but as the little aſſurance we have of the exactneſs of *Hipparchus*'s catalogue, gives cauſe to believe that many ſtars, which were not in that catalogue, were yet in the heavens; ſo we may well grant, that ſome of thoſe, that have been obſerved ſince, have not always appeared; for not to mention the ſtars obſerved in *Caſſiopeia*, in the neck of the whale, in the breaſt of the ſwan, and in *Serpentarius*; M. *Caſſini* has diſcovered many other little ones, which may very well be preſumed to be new; for inſtance, he has obſerved one of the fourth magnitude, and two of the fifth in *Caſſiopeia*, where it is certain they were not ſeen before, many aſtronomers having exactly reckoned up the ſmalleſt ſtars of that conſtellation, and yet not one of them mentioned thoſe three; he has diſcovered two others towards the beginning of *Eridanus*, where they were not to be ſeen about the end of 1664; this part of the heavens having been paſſed over by the comet that appeared then, divers other ſmall ſtars were obſerved there, but not theſe two; he alſo obſerved towards the *Arctic* pole, four of the fifth or ſixth magnitude: Nor are we to wonder, that we now obſerve more ſtars in the heavens than formerly appeared, ſince thoſe which are now no more ſeen, once appeared; for M. *Caſſini* has obſerved, that *Bayerus* has put a ſtar in *Urſa minor*, which now does not appear; that that marked A in *Andromeda* has alſo diſappeared; that in lieu of that which is marked *v* at *Andromeda*'s knee; there are two others more northerly, and that that noted *ξ* is very much diminiſhed; the ſtar placed by *Tycho* at the extremity of *Andromeda*'s chain, and which he makes of the 4th magnitude, is now ſo ſmall, that it is ſcarcely viſible; and that which is in his catalogue the 20th of *Piſces*, is now no more ſeen; but we are not therefore preſently to conclude, that thoſe ſtars that have

have been lately diſcovered, were not in the heavens before, altho' not obſerved there; for as we now know, that there are ſtars, which from time to time appear and diſappear, ſo we have cauſe to ſuſpect, that moſt of the ſtars that were not formerly ſeen, or that are now no more ſeen, or are found diminiſhed, are of the ſame nature with the ſtar in the whale's neck, and do not ceaſe to be in the heavens, tho' they appear not there; it is alſo poſſible, that theſe new ſtars were not only in the heavens, but even appeared there before they were taken notice of as new ones; and it is very probable, that it is ſo with moſt ſtars, as with that in the whale's neck, which was not obſerved at firſt, till it became of the third magnitude, altho' it has been ſince found, that it is not really ſo great when it begins to appear; but that being ſmall at firſt, it increaſes inſenſibly till it comes to that magnitude.

Of Spontaneous Generation, *as alſo of ſome* Inſects *ſmelling of* Muſk; *by Mr.* Ray. Phil. Tranſ. N° 74. p. 2219.

WHether there be any ſpontaneous or anomalous generation, as naturaliſts have generally thought, Mr. *Ray* ſays, may be juſtly queſtioned, and he is of opinion, that all inſects are the natural iſſue of parents of the ſame ſpecies with themſelves: *Fr. Redi* has gone a good way in proving this; but ſtill there remain two great difficulties, the firſt is, how to account for the production of inſects bred in the by-fruits and excreſcences of vegetables, which *Redi* aſcribes to the vegetative ſoul of the plant that yields theſe excreſcences; the ſecond difficulty is, to account for inſects bred in the bodies of other animals.

Mr. *Ray* has obſerved two ſorts of inſects, which ſmell of muſk; the one is like the common *Capricornus* or goat-chafer, which ſmells ſo ſtrong of that perfume, that you may diſcover it a good diſtance as it flies by, or ſits near you; the other is a ſmall ſort of bee, which in the ſouth and eaſtern parts of *England* is frequently to be met withal in gardens among flowers in the ſpring.

The Generation of Bees *in an old Willow*; *by Mr.* Willoughby. Phil. Tranſ. N° 74. p. 2221.

THE cartridges Mr. *Willoughby* had got at *Aſtrop* in *Auguſt* 1670, did in *July* 1671 almoſt every day afford a bee, and he could hear them gnaw out their way, before he ſaw them; ſo that there is nothing irregular in the breeding of theſe bees, only the contrivance of nature is admirable; for,

 the

the parent-bees having ſhut up their young in thoſe cells with ſufficient proviſions, before winter they all of them arrive at their full growth, or become *Nymphæ*, in which ſtate they continue all winter; the enſuing ſummer, thoſe muſt neceſſarily be firſt rouſed out of their numbneſs and changed into flies by the external heat and air, that lie next it; if any be laid ſo late, as not to have time enough to come to the ſtate of *Nymphæ* before winter, they infallibly die; and then it is no loſs or inconvenience, tho' their cells be perforated.

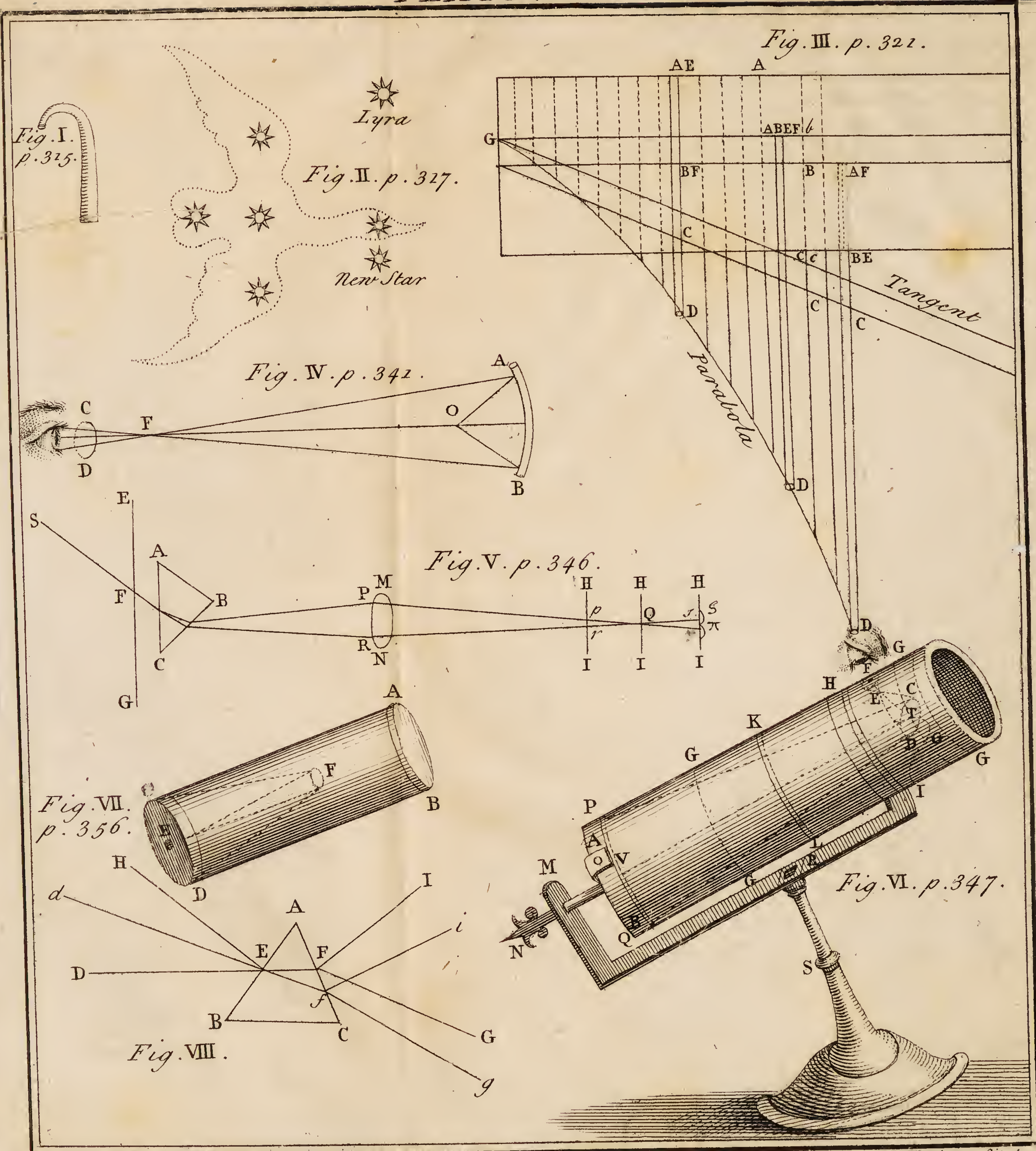
A further Account of the Stellar Fiſh, &c. Phil. Tranſ. N° 74. p. 2221.

MR. *Winthorp*, the author of this account, underſtood by the fiſherman who brought him the fiſh, that he never ſaw, nor heard of any of theſe fiſhes, except ſix or ſeven he himſelf had taken at ſeveral times, not far from the ſhoals of *Nantucket*, an iſland on the coaſt of *New-England*, when he was fiſhing for cod; this ſtellar fiſh when alive, and firſt taken out of the water reſembled, and gathered itſelf round like a wicker-baſket; after faſtening upon the bait on the hook, and holding it within its ſurrounding arms, it would not let it go, tho' drawn into the veſſel, till lying a while on deck, it began to feel the want of its natural element, and then it voluntarily extended itſelf into a flat round form; the only uſe that can be diſcerned of all that ſtructure, wherewith nature has adorned it, ſeems to be, to make a purſe-net to catch ſome other fiſh, or any other thing, fit for its food, and as a ſtore-baſket to keep ſome of it for future ſupply, or as a receptacle to prepare and defend the young ones of the ſame kind from fiſh of prey, if not alſo to feed on them, which appears probable, for ſometimes pieces of a mackarel are found within that concave ſpace, and ſometimes a ſmall fiſh of its own ſpecies: Every one of the ſmalleſt parts of this fiſh had motion when alive, and a tenacious ſtrength; but after it was dead and extended to a flat round, it was ſo brittle, that it could not be handled without breaking ſome parts of it; but by carefully laying it to dry, it was ſomewhat hardened: And Mr. *Winthorp* thinks, till a fitter *Engliſh* name be found for it, it may be called a *Basket-fiſh*, a *Net-fiſh*, or a *Purſe-net-fiſh*.

The neſt of the *Humming-bird*, ſo called from the humming noiſe it makes in flying, is very curiouſly contrived; this bird is exceeding ſmall, and only ſeen in ſummer, and generally in gardens, flying from one flower to another, and ſucking honey out

of

PLATE. X.



G. Smith del. Hulett Sculp.

of them like a bee, it does not perch on the flower, but hovers over it, and ſucks with its long bill a ſweet ſubſtance out of it: The eggs of that bird are ſo ſmall, of which two were found in the neſt, that the one weighed about five grains, and the other only 3 ½, and the whole neſt weighed no more than 24 grains.

A Calculation of the compreſſion of Air *under* Water. Phil. Tranſ. N° 75. p. 2239.

LEt ED Fig. 3. Plate X. repreſent the tube $= x$; A B the diſtance of the upper part of the tube from the ſurface of the water above or under it $= b$; F C the depth of the water from its ſurface to the bottom of the air within the tube $= a$; B C that part of it which remains filled with air within the water; C D the remaining part thereof, which is full of water; and any two of the three firſt x, b, and a being given, the other is known, and conſequently the reſt alſo; for if by the incumbent weight of 33 foot depth in water, the air in the tube is compreſſed into half the ſpace it filled before, then the ſaid 33 foot depth in water is equal to the weight or preſſure of the incumbent air on the ſurface of the water: Now, as the weight or preſſure of the air on the ſurface of the water, is to the depth of the water from its ſurface to the bottom of the air within the tube, ſo is the length of the tube filled with air, to its length filled with water; that is, according to the experiments N° 73. p. 2192, putting z for 33, or whatever, at other times and places, the weight or preſſure of the incumbent air be found to be on the ſurface of the water, for it is not always exactly the ſame;

$$z : a :: a \pm b : \frac{a^2 \pm ab}{z} = \text{CD}; \text{ and therefore}$$

$$\frac{a^2 \pm ab + za \pm zb}{z} = x; \text{ wherefore}$$

$$\frac{z}{z + a}x - a = b; \text{ and } \sqrt{:}\ \frac{b^2 \mp 2zb + z^2 + 4zx \mp b - z}{z}$$

$= a$; therefore a and b being given, x is known by the firſt equation; and a and x being given, b is known by the ſecond; and b and x being given, a is known by the third: The horizontal line B F B A F is ſubſtituted for G A B E F b, when the cloſe end of the tube is not even with the ſurface of the water, to avoid the breach cC $= b$B $= \frac{1}{4} zb$*, in the length of the tube.

N. B.

N. B. That the perpendicular immerſion of the tube or cylinder mentioned N° 73. is not to be underſtood of the depth of the bottom or open end in the water, but of the depth of the air within the tube or cylinder from the ſurface of the water, *viz.* F C and not F D.

Of Spots *in the* Sun. Phil. Tranſ. N° 75. p. 2250.

M. *Caſſini Aug.* 11. 1671, about ſix o'clock at night with a three foot glaſs obſerved two very dark ſpots in the ſun's diſk, diſtant from his apparent centre about ⅓ of his ſemi-diameter; and that he might more exactly remark their ſituation in reſpect of the ſeveral parts of the world, he made uſe of two very fine threads, cutting each other at right angles in the common focus of the two glaſſes in the axis of the teleſcope; and having directed it towards the ſun, he ſo turned it, that letting it afterwards reſt, one might ſee the ſun's centre, according to one of theſe threads, advance weſtward, this ſame thread marking in the ſun a circle parallel to the equator; and the other thread marked the circle of declination, or the ſun's horary circle: Then he obſerved, that the ſpots were in the ſouthern part of the ſun, that their elongation from this parallel, paſſing thro' his centre, could be no more than about the ſixtieth part of his diameter; and that they were ſituate on the eaſtern ſide in reſpect of the ſun's centre; he alſo meaſured ſeveral times, from ſix to ſeven at night, the time elaſped between the paſſage of the ſun's centre and that of the firſt of theſe ſpots thro' the ſaid horary circle, which ſometimes he found to be 23, ſometimes 22 ſeconds; the ſun's ſemi-diameter paſſing then in 66 ſeconds: The firſt of theſe ſpots being viewed with a teleſcope of 17 foot appeared ſomewhat of an oval figure; the other was oblong and a little curved, like the hebrew letter *Jod*; and both together were ſurrounded with a corolla or coronet made up of little dark points: *Aug.* 12th, he obſerved them from the time of ſun-riſing, and then they were perceived nearer his centre; the time between the paſſage of the ſun's centre and that of the interior edge of the coronet, which encompaſſed them both, was then 16 ſeconds; at ſeven o'clock it was but 15, and the ſouth limb of the coronet touched the parallel paſſing thro' the ſun's centre: He continued to obſerve them exactly with a larger teleſcope, from ſix in the morning to ſeven, and the firſt was found compoſed of two others, which were almoſt round and conjoined; the ſecond repreſented the ſhape of a ſcorpion, and the third was round;

round; and they were all three invironed with a coronet, consisting of a great many small obscure pricks; this coronet appeared clearer than the rest of the sun when viewed with the short glass, and darker when seen with the long; without it there were other very black points, *viz.* five near the round spot on the south-side, and another near the scorpion's tail on the north-side: At eight o'clock and 48 minutes the figure of the scorpion was seen divided into several pieces, as if his tail and arms had been cut off; the northern point appeared no more, there remaining none but those on the south-side; and the length of the enclosure of all the spots, comprehended between the extremities, was of one min. and 15 sec. and the breadth of 30 sec. At six in the evening, he found no great change in the first spot; the other two were severed into five distinct ones, encompassed with a coronet, together with five black points, which stood in a streight line, and after another manner than they did in the morning; from six at night to seven, the time between the passage of the sun's centre and that of the coronet's limb, was found to be at one time, eight sec. and at another time seven sec. and a half. The distance of the spots from the parallel passing thro' the sun's centre, was nearly the same on the north-side with what it had been observed in the morning on the south-side: *Aug.* 13, between the sun's rising, and half an hour past six in the morning, the edge of the coronet being turned to a point on the south-side, was distant from the equator on the north-side half a minute; and there was only a second of time between the passage of the sun's centre and that of the anterior edge of the coronet: At eight o'clock 30 min. the anterior edge was in the same horary circle with the sun's centre, so that in a day and a half these spots had run thro' very near $\frac{1}{3}$ of the sun's apparent semi-diameter, which gives an arch of 19 $\frac{1}{2}$ degrees of the circumference of the sun's body, and consequently their diurnal motion about the sun's axis has been 13 degrees, and the time of their periodical revolution, as far as could be conjectured in so short a time, must be about 27 $\frac{1}{2}$ days.

Of Vegetable Excrescences; *by* Dr. Lister. Phil. Transf. N° 75. p. 2256.

THE history of the purple-kermes gives a clear light for the discovery of the nature of the scarlet-kermes, a thing wholly unknown to the ancients, and is also an evident instance, that some things, confidently believed to be vegetable excrescences,

cences, are no ſuch thing, but merely contiguous to the plant, after the ſame manner the *Patella Shell-fiſh* is to the rock: Generally inſect-eggs laid upon the leaves of plants, or their reſpective worms feeding on them, do not cauſe excreſcences; thus, for inſtance, the eggs of the common red butterfly laid upon the nettle, are hatched thereon without bliſtering the plant into an excreſcence; and the ſtiff-haired, or prickly caterpillars hatched from theſe eggs feed upon the leaves, without any puncture or prejudice, ſave that they eat them up: Some inſect-eggs laid upon the leaves or other parts of plants, do, as ſoon as hatched, pierce the plant to feed on it, which is confirmed by the following inſtance, on the under-ſide of the leaves of *Atriplex Olida* certain ſmall milk-white oblong eggs were obſerved, on ſome leaves four, on others fewer or more; theſe eggs were on ſome plants unhatched, and on many of them the eggs were found adhering to the leaves, and the little maggots were already entred between the two membranes of the leaf; in other leaves of that plant thoſe maggots were found grown very big, and yet the two membranes of the leaf entire, only a little raiſed or hollow like a bladder, and the maggots of a conical figure, in *July* they were changed into *Chryſales*, and accordingly came to perfection; and to this latent way of feeding, all worm-eaten fruits, woods, *&c.* may be referred.

The Diſſection of a Porpoiſe; *by* Mr. Ray. Phil. Tranſ. N° 76. p. 2274.

THE length of this porpoiſe was three feet ſeven inches, and its circumference in the thickeſt place was two foot two inches, its ſhape was not unlike that of a tunny-fiſh, only its ſnout was longer and ſharper; its ſkin was thin, ſmooth, and without ſcales; its fins cartilaginous and flexible, not ſharp or prickly; on his back was only one fin, diſtant from the tip of his ſnout a foot and nine inches, and the baſis of it five ½ inches in length, ſo that meaſuring from the tip of his ſnout to the end of the tail, it was ſituate ſomewhat below the middle of the length of the fiſh; on the belly it had only one pair of fins, nine ½ inches diſtant from the tip of the lower jaw, much about the place, where the foremoſt pair of fins in other fiſhes uſually grow; the tail was forked, of the figure of a creſcent; the breadth thereof from one angle to the other 11 inches, and its plane parallel to the horizon, differing from other fiſhes in that it is in them perpendicular, the reaſon of which

which may be to ſupply the want of the hindmoſt pair of fins, which in other fiſhes ſerve to balance the body, and keep it up in the water, and to facilitate the fiſhes aſcent to the ſurface of the water, to which he may immediately raiſe himſelf by a gentle jerk of his tail, in order to breathe, which is as neceſſary for this fiſh as for quadrupeds; for if violently detained under water he will in a ſhort time be ſuffocated: Immediately under the ſkin lay the fat, called the blubber by ſeamen; it was firm, full of fibres, and in this ſmall fiſh an inch thick, encompaſſing the whole body, back, belly and ſides; and its uſe may be to keep the cold water at a diſtance from the blood, to prevent the hot ſteams of the blood from evaporating, and by that means preſerving its natural heat; and poſſibly alſo to lighten or counterpoiſe the body of the fiſh, which otherwiſe would be too heavy to move and ſwim in the water: Under the blubber lay the muſcular fleſh, like that of quadrupeds, but of a darker colour: The body was divided into three regions, *viz.* the head, breaſt and belly, the veſſels and *Viſcera* in each region were generally the ſame as in quadrupeds; the *Abdomen* was encompaſſed with a ſtrong *Peritonæum*; the guts were joined to the meſentery, and of a great length, meaſuring 48 feet, without any difference of great and ſmall, and there was no *Cæcum* or blind-gut; the ſtomach was of an odd make, being divided into two large bags, beſides other ſmaller ones; there was found in it a great many of thoſe little long fiſhes dug out of the ſands at low-water, called ſand-eels in ſome places, and by others launces, and by *Geſner*, *Ammodytæ*: The liver was of a moderate ſize, ſituated in the right ſide, and divided into two lobes, without any gall-bladder: The *Pancreas* was large, ſticking cloſe to the third bag of the ſtomach, into which alſo its *Ductus* enters and empties itſelf: The ſpleen was ſmall and roundiſh: The kidneys were large, ſticking cloſe to the back, and lying contiguous to each other, conſiſting of many little glands, like to, but ſmaller than thoſe of an ox; it was of a flat figure, without any *Pelvis* in the middle, but the ureters went out at the lower end: The bladder of urine was oblong, and ſmall in proportion to the animals bulk, with a round ligament on each ſide, made of the umbilical arteries: The *Penis* was long and ſlender, with a ſmall ſharp glans; it appears not externally, lying concealed in its ſheath within the body, doubled up or rather reflected in the form of the letter S, like that of a bull: The teſticles lie within the cavity of the *Abdomen* on each

each ſide, as in a hedge-hog, and ſome other quadrupeds, of an oblong figure; and their internal ſubſtance and veſſels exactly like thoſe of quadrupeds; the ſeminal veſſels perforate the *Urethra* with many little holes, whereof four are moſt conſpicuous, a little above the neck of the bladder: It had ſix ſhort ribs without any cartilages, and ſeven with cartilages on each ſide; the breaſt-bone was very ſmall: The diaphragm muſcular, as in quadrupeds: The heart large, included in a *Pericardium*, with two ventricles and their valves, together with coronary arteries and veins; in a word, the whole ſtructure and ſubſtance of the heart and lungs agreed exactly with that of quadrupeds: The windpipe was very ſhort, as it muſt needs be, the fiſh having no neck; the *Larynx* was of a ſingular figure, running out with a long neck and a knob at the end: The pipe in the head thro' which this fiſh draws breath and ſpouts out water, lies before the brain, and ends externally in one common hole, but internally is divided by a bony *Septum*, as it were into two noſtrils; but below it opens again into the mouth by one hole; this lower orifice is furniſhed with a ſtrong *Sphincter*, the ſides of the pipe are lined with a glandulous fleſh, which compreſſed yields from many *Papillæ* or little holes a certain glutinous liquor: Above the noſtrils is a ſtrong valve or membrane like an *Epiglottis*, which ſerves to ſtop the pipe, to prevent the waters getting in involuntarily; within the pipe are ſix blind holes, four towards the ſnout, two above the valve that ſtops the noſtrils, and two beneath it, two towards the brain, with a long but narrow cavity for the ſenſe of ſmelling, as may be gueſſed, tho' on opening the brain neither olfactory nerves nor the *Proceſſus Mamillares* could be found: The eyes are ſmall, conſidering the bigneſs of the fiſh, and ſituated at a good diſtance from the baſis of the brain: The ſnout is long and furniſhed with very large muſcles to turn up the ſand at the bottom of the ſea for finding fiſhes, as appeared from obſerving nothing but ſand-eels in his ſtomach, which, as was ſaid above, lie buried in the ſand: The brain and *Cerebellum*, as to their ſubſtance and windings are the ſame as in quadrupeds, only differing in figure as being ſhorter; but what they want in length they make up in breadth; they have alſo the like *Teguments* called *Dura* and *Pia Mater*, with ſix or ſeven pair of nerves, beſides the optic, the ſame ventricles, only in the *Medulla Oblongata* the protuberances called *Nates* and *Teſtes* were not obſerved: The ſkull is not ſo ſtrong and thick, as in quadrupeds, but articulated after the ſame manner

to

to the firſt *Vertebræ* of the back-bone; this largeneſs of the brain, and its reſemblance to that of a man, argue this creature to be of more than ordinary wit and capacity, and make the ſtories related by *Herodotus*, *Pliny* the elder, and *Pliny* the younger, more probable: It had in each jaw 48 teeth, ſtanding in a row like little blunt pegs: The tongue was flat above, and of an equal breadth to the very tip, and furniſhed with teeth about the edges, and tied firmly down to the bottom of the mouth all along the middle, as *Ariſtotle* truly ſays; whence it is to be wondered, that *Rondeletius* ſhould herein contradict him, unleſs in this particular the dolphin differ from the porpoiſe: For Mr. *Ray* takes the dolphin to be the *Phocæna* of the ancients, which is a leſſer ſort of dolphin, and not the *Delphinus*; as for that fiſh, which our ſea-men called the dolphin, with teeth on its tongue, ſmall ſcales and fins like a rock, of a pleaſant ſmell and taſte; Mr. *Ray* takes it to be entirely different from the dolphin of the ancients: He obſerved not any noſtrils in this fiſh, beſides thoſe in the fiſtula or pipe, nor any auditory paſſages, in which alſo *Ariſtotle* agrees, which yet *Rondeletius* found out near the eyes; and there was obſerved in the ſcull a bone anſwering to the *Os Petroſum*, which undoubtedly was deſigned for the organ of hearing: As for the name porpoiſe, he agrees with *Geſner*, that it was ſo called, *quaſi Porcus Piſcis*, moſt nations calling this fiſh *Porcus Marinus*, or the ſea-ſwine, and it reſembles a ſwine in many particulars, as the fat, the ſtrength of the ſnout, *&c.*

Ichneumon-waſps, *and the manner of laying their Eggs in the Bodies of* Caterpillars; *by* Mr. Willoughby. Phil. Tranſ. N° 76. p. 2279.

DR. *Liſter* is of opinion that the *Muſcæ Ichneumones* lay their eggs in the bodies of caterpillars, which ſeems to be very ingenious and true; theſe *Ichneumones* have four wings like bees, their body hanging to their breaſt by a ſlender ligament, as in waſps; moſt, if not all of them, have ſtings and are produced of a maggot, that ſpins itſelf a *Theca* or caſe, before it becomes a *Nympha*; there is a great variety of them, ſome breed as bees do, laying an egg which produces a maggot, and which they feed till it comes to its full growth; others, as may be gueſſed, inject their eggs into plants, the bodies of living animals, maggots, *&c.* for it is very ſurpriſing to obſerve, that a large caterpillar, inſtead of becoming a butterfly, ſhould produce ſometimes one, ſometimes two or three,

and ſometimes a whole ſwarm of *Ichneumons*; he obſerved this anomalous production in a great many ſorts of caterpillars, both hairy and ſmooth, in ſeveral ſorts of maggots, and which is uncommon in one water-inſect; when many of theſe *Ichneumon* maggots come out of the body of the ſame caterpillar, they weave all their *Thecæ* together into one bunch, which is ſometimes round, with a web about it, juſt like a bag of ſpiders eggs; but none of them feed on ſpiders eggs, which ſurmiſe has been owing to their conglobated *Thecæ* reſembling ſpiders eggs: One of the green caterpillars common in the heaths in the north, proceeded ſo far in her natural change, that ſhe encloſed herſelf in a great brown *Thecæ* almoſt of the ſhape of a bottle, which was filled with a ſwarm of *Ichneumons*; and it has been obſerved, that from the very *Aurelia* itſelf an *Ichneumon* hath proceeded; which is a thing very uncommon, that the caterpillar, ſtung and impregnated by the *Ichneumon*, ſhould notwithſtanding be ſo far unhurt, as to make herſelf a *Theca*, and to become an *Aurelia*; Mr. *Willoughby* has often ſeen a great *Ichneumon* dragging along a caterpillar on the highway, and the ſame thing was obſerved by Mr. *Wray*, which after ſhe had haled the length of a pearch, ſhe laid down, and taking out a little pellet of earth, with which ſhe had ſtopped the ſmall mouth of a worm-hole, goes down into it, and in a little time comes up again, and draws the caterpillar down with her into the hole, and there leaves it, and ſhe afterwards not only ſtopped but filled up the hole, ſometimes carrying in little clods, and ſometimes ſcraping duſt with her feet, and throwing it backwards into the hole, and afterwards ramming it cloſe; once or twice ſhe flew up into a pine tree, perhaps to fetch cement; when the hole was full, and level with the ground about it, ſhe laid two pine leaves near the mouth of the hole and flew away; upon digging for the caterpillar it was found very deep in the earth: Mr. *Willoughby* had obſerved a ſort of *Ichneumons* or rather waſps, which prey on ſeveral ſorts of flies, they take hold of them by the heads and carry them under their bellies; theſe make holes at a great depth in the ground, in which they lay their young, and feed them with theſe flies, for creeping backwards into the ground they drag the flies after them: They may poſſibly at firſt lay their eggs in the very body of a fly, but one being not ſufficient to bring the young to its full growth, they feed it with more flies; for their *Thecæ* are at laſt all covered over with the wings, legs and other parts of flies.

Muſk-

Muſk-ſcented Inſects; *by* Dr. Liſter. Phil. Tranſ. N° 76. p. 2281.

DR. *Liſter* obſerved the two inſects mentioned by Mr. *Ray*, N° 74. p. 2220 ſmell very ſtrong of muſk; the ſmall bees are very freqnent in the woods in *Lincolnſhire*, and they are to be found about the latter end of *April* in paſtures and meadows, on the early-blown flowers of a ſort of *Ranunculus*, tho' it is ſomething improper to ſay bees feed on flowers; they are alſo frequent on the flowers of dandelion, *&c.* The ſweet beetle is a very large inſect, and well known about *Cambridge*; but all the trials made to preſerve them with their ſmell proved ineffectual; for both theſe ſorts of inſects will of themſelves in a few weeks become almoſt quite ſcentleſs: There is another ſweet ſmelling inſect, which is a ſix-footed worm, feeding on *Gallium Luteum.*

Of Vegetable Excreſcences *and* Ichneumon-worms; *by* Dr. Liſter. Phil. Tranſ. N° 76. p. 2284.

DR. *Liſter* thinks, that the ſubſtance of the vegetable excreſcences, in which the *Ichneumon-worms* are found, is rather augmented than diminiſhed or worm-eaten; and he obſerved a poppy-head ſwelled to a monſtrous bulk, and yet all the cells were not full of *Ichneumons*, but ſome had ripe and good ſeed in them: The ſwarms of *Ichneumons* coming out of the ſides of caterpillars do immediately make themſelves up into bunches, and each particular *Theca*, from the cabbage caterpillar, for inſtance, is wrought about with yellow ſilk, as thoſe from the black and yellow *Jacobæa* caterpillar with white; and he never obſerved theſe *Thecæ* covered with webs except thoſe of the green caterpillars, common in the heaths of *Lincolnſhire*, which are fixed to bents or other plants; and when he firſt obſerved them he thought he found a caterpillar equivalent to the *Indian* ſilk-worm; but upon cutting them in two, inſtead of a caterpillar's *Chryſalis* he found a ſwarm of *Ichneumons*, they are four times bigger than the egg-bag of any *Engliſh* ſpider: He has had the *Ichneumon-worms* in ſeveral boxes for 10 or 12 days, feeding on the very cakes of ſpider's eggs, before they wrought themſelves *Thecæ* for their further change; and they ſeldom exceed the number of five to one cake of eggs.

Observations of Solar Spots; *by Dr.* Hook. Phil. Transf. N° 77. p. 2295.

AUG. 30th, 1671, Dr. *Hook* obferved a large fpot about noon, in the centre of the fun's difk: *Sept.* 1ft, at 3 o'clock, he faw the fame fpot moved about a quarter of the fun's diameter weftward; it confifted of one greater, and two leffer black fpots with a dufky cloud encompaffing them. The diameter of the whole phænomenon was about $\frac{1}{72}$ of the fun's diameter, and it was diftant from the neareft limb $\frac{18}{72}$, that is, $\frac{1}{4}$ of the fun's diameter; this he examined and meafured feveral times, and found it very exact.

Observations on an Eclipfe *of the* Moon; *by Dr.* Hook. Phil. Tranf. N° 77. p. 2296.

SEPT. 8th, 1671, 7 h. 27 $\frac{1}{2}$ min. Dr. *Hook* firft obferved the moon to be eclipfed, it then began to be enlightened, the total darknefs being already paft, the fhadow paffed thro' the middle of the fpot, called by *Hevelius*, *Mons Porphyrius*; half of the faid fpot appearing without the fhadow, and the other half darkened by it; 7 h. 49 min. the fhadow paffed thro' the middle of *Mons Sinai*, and thro' the middle of the eaftermoft of the three lakes, called *Mare Adriaticum*, and juft touched the ridge of the *Apennine Mountains*; 7 h. 54 m. it paffed the middle of the ifle *Besbicus* in the *Propontis*; 8 h. $\frac{1}{2}$ m. it paffed thro' the *Streights* of the *Pontus Euxinus*, at the promontories *Acherufia* and *Ariftes*; 8 h. 6 $\frac{1}{2}$ m. it touched the *Palus Mæotis*, which was then diftant from the neareft limb of the moon $\frac{1}{3}$ of its leffer diameter; 8 h. 17 m. the fhadow went off the body of the moon upon the innermoft limb-line of *Hevelius*'s large map of the moon at the 29th divifion, juft without the *Infula Major* of the *Cafpian Sea*; the dufkifh *Penumbra* did not quite leave the limb of the moon without fome kind of darknefs, till 8 h. 29 m. at which time he found that fide of the moon laft deferted by the fhadow, was full as bright and clear as the other: In four or five minutes after the fhadow was gone off, he perceived a faint reprefentation of colours on that part of the moon's body, which was moft affected by the *Penumbra*, fomewhat refembling the colours of a faint halo about the moon; this grew gradually fainter, and in a few minutes was no more to be feen; it did not feem to be caufed by any clouds or exhalations in the air, the fky near the moon being very clear, and the faid colours appearing no where, but on the dufky part of its phafis;

phaſis; poſſibly it might be cauſed by the refraction of the light from the ſun thro' the atmoſphere about the earth.

Of Muſk-Ants; *by Dr.* Liſter. Phil. Tranſ. N° 77. p. 3002.

DR. *Liſter* found, in a ſandy ditch-bank, a very ſmall ſort of piſmires; thoſe without wings were of a light yellow, and broken at the noſtrils, emitted an acid ſcent; but thoſe of the ſame bank, and with wings, were coal-black, which being bruiſed and ſmelt to, emitted ſuch a fragrant muſk-like ſcent, that he could not endure it for its ſtrength; but being kept ſome time, their ſmell would not offend the moſt delicate. Mr. *Willoughby* found the goat-chafer, or ſweet-beetle out of ſeaſon, as to its ſmell, and the time of coition is the moſt remarkable ſeaſon for their ſweeteſt and ſtrongeſt ſcent.

Of Vegetable Excreſcences, *and* Ichneumon Waſps; *by Dr.* M. Liſter. Phil. Tranſ. N° 77. p. 3003.

THE fibrous parts of many vegetable excreſcences, ſeem not to be the food of the worm found in them, that is, that the worms which produce ichneumons, to which ſpecies of inſects this propoſition ſhould be limited, do not ſeem to devour the ſubſtance or fibrous part, as other worms eat the kernel of nuts, *&c.* but that the vegetable excreſcences increaſe in bulk, and riſe as the worms feed: It is obſervable, that ſome of the ichneumons delight to feed on a liquid ſubſtance, as the eggs of ſpiders, the juices within the bodies of caterpillars and maggots; whence it may be conjectured, that thoſe of the ſame ſpecies, found in vegetable excreſcences, may in like manner feed on the juices of vegetables; and the dry and ſpungy texture of ſome of thoſe kinds of excreſcences ſeems to evince this; for if you cut in pieces a wild poppy-head, or the great and ſoft balls of the oak, you will find in the partitions, in which the worms are lodged, nothing but a pithy ſubſtance like that of young elder; and if any cells eſcape the worms, the ſeeds therein will be found entire and ripe; whence very probably it may be inferred, that they feed upon the liquid pulp of the tender ſeeds, and leave the ſubſtance or fibrous part to be expanded into an excreſcence.

Ichneumon properly ſignifies the *Egyptian* rat, and it has its name from its hunting or tracing out the eggs of crocodiles and aſps; now a like obſervation made by ſome of the ancients on certain inſects of the waſp kind, occaſioned the application of that name to waſps, as well as the *Egyptian* rat; there is but

but one paſſage in all antiquity concerning theſe waſps, *viz.* in *Ariſtot. de Hiſt. Anim. lib.* 5. *c.* 20. which *Pliny*, *lib.* 11. *c.* 21. hath rendered, thus, *Veſpæ, quæ Ichneumones vocantur (ſunt autem minores quam aliæ) unum genus ex araneis perimunt, phalangium appellatum, & in nidos ſuos ferunt, deinde illinunt, & ex iis, incubando, ſuum genus procreant*; that is, the waſps called *Ichneumons*, and which are ſmaller than other waſps, kill a ſpecies of ſpiders, called *Phalangium*, and carry them to their neſts, after which they beſmear them, and by incubation produce their own ſpecies out of them: And there ſeems ſufficient reaſon to believe, that the inſects treated of above, are for kind, the ichneumons of the ancients.

Obſervations on the Solar Spots. Phil. Tranſ. N° 78. p. 3020.

IN the obſervation made *Auguſt* 1671, the anterior limb of the miſty crown encloſing all the ſpots was in the ſame horary circle with the ſun's centre: *Aug.* 14th, in the morning, from 6 to 7 o'clock, there paſſed 15″ of time between the paſſage of the anterior limb of the ſaid crown, and the paſſage of the ſun's centre thro' the ſame horary circle; and then the ſouthern limb of the crown was a minute and a half diſtant to the north, from the parallel of the equator, paſſing thro' the ſame centre of the ſun; the figure of the firſt ſpot was almoſt the ſame with that of the preceeding day; the ſecond had aſſumed the form of a heart, whoſe point was turned northward, and its baſe lay between ſouth and eaſt; three other ſmall ſpots, diſpoſed triangular-wiſe, ſtood over the ſaid baſe, accompanied with two others on a line turned to the ſouth; and they were all encompaſſed by a crown running out into a point on the ſouth-ſide; and on the north-ſide, eaſtward, it had an appendix. The 15th, at 6 in the morning, there paſſed 27″ between the paſſage of the anterior limb of the crown, and that of the ſun's centre thro' the ſame horary circle; the ſouthern limb of the ſame crown was 2 min. and a half diſtant from the parallel of the equator paſſing thro' the ſun's centre, whoſe diameter paſſed in 2′ 9″ thro' the ſame horary circle; the firſt ſpot had a little changed its figure; the ſecond was quadrangular, longer from eaſt to weſt, than from north to ſouth; it appeared bigger than ordinary, and had on its ſides within the compaſs of the crown, three other ſmall ſpots; and four more were ſeen without the ſaid crown on the ſouth-ſide. *Aug.* 16th, at 6 in the morning, there were 27″ between the paſſage of the ſun's anterior limb, and that of the anterior limb of the crown thro'

thro' the ſame horary circle, and 38″ between the paſſage of the anterior limb of the crown, and that of the ſun's centre; the ſouthern limb of the crown was 3 ½ min. diſtant from the parallel of the equator, paſſing thro' the ſun's centre to the north; and the obſervation being made ſtill more exactly at half an hour paſt 7 the ſame morning, this diſtance was found 3′ 33″. The figure of the firſt ſpot in the beginning of the obſervation differed not much from that of the preceeding day; but afterwards it was ſeen divided into two; the ſecond, which likewiſe ſeemed to be the ſame at firſt, was afterwards divided into three, with black and dark points without the crown on the ſouth-ſide. The ſame day at 6, and 15′ in the afternoon, the figures of theſe ſpots were changed much; the two foremoſt were part of that which in the morning appeared as one; the other two following the two firſt were in the morning a part of the ſecond; and without were five points on the ſouth ſide, and two more a little further north, which points were ranged as in another area, made up of other points, ſo ſmall that they could ſcarce be perceived. *Aug.* 17th, in the morning, immediately after ſun-riſing, there appeared three very dark ſpots, which in a manner formed theſe letters F *n* *J*, poſited from eaſt to weſt, and included in their uſual crown, which extended two arms, or handles, one to the ſouth, the other to the north; theſe paſſed 18″ between the paſſage of the foremoſt limb of the ſun, and that of the foremoſt limb of the crown, and 47″ ½ between the paſſage of the anterior limb of the crown, and the paſſage of the ſun's centre; the ſouthern limb of the ſame crown was 11′ 17″ diſtant from the parallel that touched the ſun on the north-ſide, and 4′ 38″ from the parallel that paſſed thro' his centre. *Auguſt* 18th, at 7 in the morning, the ſpots, which appeared thro' ſome clouds, had almoſt the ſame ſhape with thoſe of the preceeding day, with this difference, that they were a little cloſer together, from eaſt to weſt; there were 13″ between the paſſage of the anterior limb of the ſun, and that of the anterior limb of the ſpot thro' the ſame horary circle, and 52″ ½ between the paſſage of the foremoſt limb of the ſpot to that of the centre; the ſouthern limb of the ſpot was diſtant 9′ 13″ from the parallel that touched the ſun's northern limb, and 6′ 41″ from the parallel that paſſed thro' his centre: At 5 o'clock in the afternoon of the ſame day, there elapſed 11″ between the paſſage of the anterior limb of the ſun, thro' the ſame horary circle, and that of the anterior limb of the crown, and 54″ ½

from that to the paſſage of the ſun's centre; the limb of the crown, next the parallel, paſſing thro' the ſun's centre was diſtant from the ſame parallel 7′ 40″. *Aug.* 19th, from 4 to 5 in the evening, the ſpot appeared oblong near the ſun's circumference, from which it was diſtant about the breadth of the ſame ſpot.

The apparent velocity of the ſpots, when they approached the ſun's centre gave ground to determine their apparent periodical revolution about the ſun's axis to be about 27 ½ days, ſuppoſing them either adhering to his ſurface, or at leaſt near it; and conſequently, that from the morning of *Aug.* 13th, when they were near his centre, they ſhould take between ſix and ſeven days to arrive at the limb of his apparent diſk, which in effect has been obſerved to happen; for ſince the morning of *Aug.* 13th, to the evening of *Aug.* 19th, when they were ſeen near the limb, are 6 ½ days, and then they were ſtill ſo far diſtant from it, that it was eaſy to judge, they would not diſappear that day; *Aug.* 20th, which was not full ſeven days from their arrival at the middle of the diſk, they diſappeared: The apparent velocity near the centre, was ſuch, that if it had continued the ſame, the ſpots would have arrived at the limb of the diſk in four days; but in this hypotheſis, this apparent velocity was to become leſs according as the ſpots ſhould remove from the centre, and in effect it ſo happened: The diminution of the length of the miſty crown was in a manner proportionable to the diminution of the apparent velocity; for when this crown was in the middle, and in a ſituation wherein its true figure could be beſt ſeen, it appeared oblong, and of the form of an human ear, its greateſt diameter regarding eaſt and weſt; but near the limb, this ſame diameter ſeemed to ſhorten, and after appearing greateſt in its firſt ſituation, it appeared leaſt in this, becauſe it was almoſt in a circle that paſſed thro' the ſun's centre, whoſe equal arches are by ſo much the more oblique, by how much they approach the more to the limb of his diſk, and conſequently appear leſs, according to the rules of optics; mean time the diameter, that was turned from ſouth to north, was apparently of the ſame bigneſs it had near the centre, becauſe it was in a circle almoſt parallel to the horizon of the ſun, which formed the repreſentation of its limb, and whoſe equal arches, by the ſame optical reaſons, do not appear contracted.

Obſer-

Observations on Saturn. Phil. Tranf. N° 78. p. 3024.

IT is known, that *Saturn* is for the moft part feen with *Anfæ*, or arms faftened to the two fides of his difk, when viewed with fome large telefcopes, and that he does not refume his round figure till every fifteenth year, and this change was to happen in *July* and *Auguft* 1671, according to the hypothefis and predictions of M. *Huygens*, publifhed 1659; but this round figure of *Saturn* hath been perceived fooner, *viz.* ever fince the end of *May*, at a time when he was diftant enough from the fun, and the horizon to be well obferved, and continued of this figure to the 11th of *Auguft*; but three days after, he was feen with very narrow arms.

Further Obfervations on Glow-worms; *by Mr.* Templer. Phil. Tranf. N° 78. p. 3035.

JUne 1ft, 1671, after feveral trials of different pofitions, Mr. *Templer* found the glow-worm would not fometimes fhine when in motion, but when it fhone at all, it was obferved, that fome part or other of it moved: Putting it into an urinal of white glafs, at 9 o'clock at night, it crauled nimbly in it, and extended itfelf beyond an ordinary length, yet it did not fhine fo clear, as in its box when opened; putting the urinal into water for about half an hour, it yielded a delightful irradiation thro' the water; upon depreffing the urinal into the water, till the bottom almoft reached that of the bafon, and looking in at the top of the urinal, a fair light was feen, but upon lifting the glafs out of the water, it was obferved to fhine very little; after that, putting it into its box, it fhone ten times greater than in the urinal. *June* 14th, the worm feemed dead, and being fhut up in a box would give no light, tho' it was betwixt 9 and 10 at night; but in the uncovered box, or in the urinal, it fhone faintly, and the light was of a far different colour from what it was formerly. On pricking the worm, its fhining was not obferved to encreafe: It is hard to determine when a glow-worm is dead, for it may be kept for many days, even weeks, and feem dead, and yet afterwards both walk and fhine again.

Veins *obferved in* Plants; *by Dr.* M. Lifter. Phil. Tranf. N° 79. p. 3052.

DR. *Lifter* made fome obfervations on the veins of plants, or fuch ducts, as feem to contain and carry in them their nobleft juices, analogous to human veins; Thofe parts of a

plant, called by *Pliny*, *lib.* 16. *c.* 38. *Venæ* and *Pulpæ*, are nothing other, but what Dr. *Grew* calls fibres and insertments, or the ligneous body interwoven with that which he takes to be the cortical, that is, the several distinctions of the grain: Now, that these vessels are not the pores of the ligneous body, is plain in a transverse cut of *Angelica sylvestris magna vulgatior J. B.* the veins there very clearly discover themselves to be distinct from fibres, observable in the *Parenchyma* of the same cortical body, the milky juices always rising on the side, and not in any fibre; also in a like incision of a burdock in *June*, the juice springs on each side of the radii of the woody circle; that is, in the cortical body and pith only; again, where there is no pith, none of this juice is observed, and consequently none of these veins, as in the roots of plants and trunks of trees, but always in the bark of either: These particulars are plainly observable in the *Spondilium*, *Cicutaria*, many of the thistle-kind, &c. Further, neither are they in all probability of the number of the pores, described by Dr. *Grew* in the cortical body, or pith; nor are these pores extended by the breadth of the plant, because the course of the juice in these vessels is according to the length of the plant, as may be plainly traced in the pith of a dried fennel-stalk, pursuing them by dissection quite thro' the length of the pith: And the reasons for their being vessels, are as follow: 1. Because they are to be found in the pith, and sometimes in the cortical body of a plant, not included within the common tunicle of any fibres; and if they had not their own proper membranes, there is no reason why the very porous and spongy body of the pith and cortex should not in all their parts be filled alike with the juice, and not rise, as it plainly does, in a few determinate and set places, that is, according to the disposition of these vessels. 2. The sudden springing of the milky juice out of the pores of *Cataputia minor Lobel* upon a ligature; for if there was no coated vessel to hold this juice, we might well expect its springing out upon the bare ligature, as when a wet sponge is squeezed; and it is very probable, that these vessels are in all plants whatsoever: The primary use of these veins seem to be to convey the *Succus nutritius* of plants, because there is no vegetation where they are not; as is seen if an engrafted branch be bared and stripped of the clay, &c. in *June*, the vegetation will appear to have been made only by the bark, and not by the wood, that is, in the place where these vessels are: A secondary use is the furnishing of our shops, for it is from these veins that all our vegetable drugs are extracted.

A new Theory *of Light and* Colours; *by* Mr. Iſaac Newton. Phil. Tranſ. N° 80. p. 3075.

IN 1666 Mr. *Newton* in order to try the celebrated *Phænomena* of colours procured a triangular glaſs-priſm, and having darkened his chamber he made a ſmall hole in his window-ſhutter, to let in a ſufficient quantity of the ſun's light, and placed a priſm at its entrance, that it might be refracted to the oppoſite wall: It was at firſt very agreeable to obſerve the vivid and intenſe colours produced thereby; but afterwards applying himſelf to conſider them more carefully, he was ſurpriſed to ſee them in an oblong form, which, according to the received laws of refraction, ſhould have been circular; they were terminated at the ſides by ſtraight lines, but at the ends, the decay of light was ſo gradual, that it was difficult to determine juſtly their figure, yet they ſeemed ſemicircular: comparing the length of this coloured *Spectrum* with its breadth, he found it about five times greater; a diſproportion ſo extraordinary, that it excited in him an uncommon curioſity of examining whence it might proceed; he could ſcarce think that the various thickneſs of the glaſs, or the termination with ſhadow or darkneſs, could have any influence on light to produce ſuch an effect; yet, he did not think it amiſs, firſt to examine theſe circumſtances, and ſo try what ſhould happen by tranſmitting light thro' parts of the glaſs of divers thickneſſes, or thro' holes in the window of different bigneſſes, or by ſetting the priſm without, in ſuch a manner that the light might paſs thro' it, and be refracted, before it was terminated by the hole; but none of theſe circumſtances were found material; the faſhion of the colours was in all theſe caſes the ſame: Again he ſuſpected, whether any unevenneſs in the glaſs, or other contingent irregularity might not dilate theſe colours; and to try this, he took another priſm like the former, and placed it in ſuch a manner, that the light paſſing thro' them both might be refracted contrary ways, and thus be returned by the latter into that courſe from which the former had diverted it; for by this means, he thought the regular effects of the firſt priſm would be deſtroyed by the ſecond, but the irregular ones more augmented by the multiplicity of refractions. The event was that the light, which by the firſt priſm was diffuſed into an oblong form, was by the ſecond reduced into an orbicular one, with as much regularity, as when it did not at all paſs thro' them; ſo that, whatever was the

cauſe

cauſe of that length, it was not any contingent irregularity: He then proceeded to examine more critically, what might be effected by the difference of the incidence of rays coming from different parts of the ſun, and for that end, he meaſured the ſeveral lines and angles, belonging to the image; its diſtance from the hole or priſm was 22 foot; its utmoſt length $13\frac{1}{4}$ inches, its breadth $2\frac{5}{8}$, the diameter of the hole $\frac{1}{4}$ inch, the angle which the rays, tending towards the middle of the image, made with thoſe lines, in which they would have proceeded without refraction, was $44^\circ\ 56'$; and the vertical angle of the priſm, $63^\circ\ 12'$; alſo the refractions on both ſides the priſm, that is, of the incident and emergent rays, were as near, as he could make them, equal, and conſequently about $54^\circ\ 4'$, and the rays fell perpendicularly on the wall: Now ſubducting the diameter of the hole from the length and breadth of the image, there remained 13 inches the length, and $2\frac{3}{8}$ the breadth, comprehended by thoſe rays, which paſſed thro' the centre of the ſaid hole, and conſequently the angle of the hole, which that breadth ſubtended, was about $31'$, anſwerable to the ſun's diameter; but the angle which its length ſubtended was more than five ſuch diameters, *viz.* $2^\circ\ 49'$. Having made theſe obſervations, he firſt computed from them the refractive power of that glaſs, and found it meaſured by the ratio of the ſines, as 20 to 31; and then by that ratio, he computed the refraction of two rays flowing from oppoſite parts of the ſun's diſk, ſo as to differ $31'$ in their obliquity of incidence, and found, that the emergent rays ſhould have comprehended an angle of about $31'$, as they did before they were incident; but becauſe this computation was founded on the hypotheſis of the proportionality of the ſines of incidence and refraction, which tho' by his own experience he could not imagine to be ſo erroneous, as to make that angle but $31'$, which in reality was $2^\circ\ 49'$; yet his curioſity cauſed him again to take his priſm, and placing it at his window, as before, he obſerved, that by turning it a little about its axis to and fro, ſo as to vary its obliquity to the light, more than an angle of four or 5°, the colours were not thereby ſenſibly tranſlated from their place on the wall, and conſequently by that variation of incidence, the quantity of refraction was not ſenſibly varied: By this experiment therefore, as well as by the former computation, it was evident, that the difference of the incidence of rays, flowing from divers parts of the ſun, could not make them after decuſſation diverge at a ſenſibly greater angle, than that

that at which they before converged, which being at moſt, but 31′ or 32′, there ſtill remained ſome other cauſe to be found out, from whence it could be 2° 49′. Then he began to ſuſpect whether the rays, after their trajection thro' the priſm, did not move in curve lines, and according to their greater or leſs curvity tend to different parts of the wall; and his ſuſpicion was encreaſed when he remembred that he had often ſeen a tennis-ball, ſtruck with an oblique racket, deſcribe ſuch a curve line; for, a circular as well as a progreſſive motion being communicated to it by the ſtroke, its parts on that ſide, where the motions conſpire, muſt preſs and beat the contiguous air more violently than on the other, and there excite a re-action of the air proportionably greater; and for the ſame reaſon, if the rays of light ſhould poſſibly be globular bodies, and by their oblique paſſage out of one medium into another acquire a circular motion, they ought to feel the greater reſiſtance from the ambient æther, on that ſide, where the motions conſpire, and thence be continnally bended to the other; but notwithſtanding this plauſible ground of ſuſpicion, when he came to examine it, he could obſerve no ſuch curvity in them; and beſides, which was enough for his purpoſe, he obſerved, that the difference betwixt the length of the image, and diameter of the hole, thro' which the light was tranſmitted, was proportionable to their diſtance: The gradual removal of theſe ſuſpicions, did at length lead him to the *Experimentum Crucis*, which was this; he took two boards, and placed one of them cloſe behind the priſm at the window, ſo that the light might paſs thro' a ſmall hole, made in it for that purpoſe, and fall on the other board, which he placed at about 12 foot diſtance, after making a ſmall hole in it, for ſome of that incident light to fall thro'; then he placed another priſm behind this ſecond board, ſo that the light trajected thro' both the boards, might paſs thro' that alſo, and be again refracted before it arrived at the wall; this done, he took the firſt priſm in his hand, and turned it to and fro ſlowly about its axis, ſo much as to make the ſeveral parts of the image, caſt on the ſecond board, ſucceſſively paſs thro' the hole in it, that he might obſerve to what places on the wall the ſecond priſm would refract them; and he ſaw by the variation of thoſe places, that the light tending to that end of the image, towards which the refraction of the firſt priſm was made, did in the ſecond priſm ſuffer a refraction conſiderably greater than the light tending to the other end; and ſo the true cauſe of the

length

length of that image was detected to be no other, than that light consists of *rays differently refrangible*, which without any regard to a difference in their incidence, were, according to their degrees of refrangibility, transmitted towards different parts of the wall: And from this he understood, that the perfection of telescopes was hitherto limited, not so much for want of glasses truely figured according to the prescription of optic writers, as was till then imagined, as because that light itself is a *heterogeneous mixture of differently refrangible rays*; so that were a glass so exactly figured, as to collect any one sort of rays into one point, it could not collect those also into the same point, which having the same incidence on the same medium, are apt to suffer a different refraction; and he wondered, the difference of refrangibility being so great, that telescopes should arrive at the perfection they are now at; for measuring the refraction in one of his prisms, he found, supposing the common sine of incidence on one of its planes was 44 parts, the sine of refraction of the outmost rays on the red end of the colours, made out of glass into air, would be 68 parts, and the sine of refraction of the outmost rays on the other end, 69 parts, so that the difference is about a 24th or 25th part of the whole refraction; and consequently the object glass of any telescope cannot collect all the rays, which come from one point of an object, so as to make them meet at its focus in less room than in a circular space, whose diameter is the 50th part of the diameter of its aperture; which is an irregularity, some hundreds of times greater, than a circularly coloured lens, of so small a section as the object-glasses of long telescopes are, would cause by the unfitness of its figure, were light uniform: This consideration made Mr. *Newton* take reflexions into consideration, and finding them regular, so that the angle of reflexion of all sorts of rays was equal to their angles of incidence; he perceived that by that means optic instruments might be brought to any degree of perfection imaginable, providing a reflecting substance could be found, which would polish as finely as glass, and reflect as much light as glass transmits, and the art of communicating to it a parobolical figure be also attained; but there seemed to be very great difficulties, and almost insuperable; when he further considered, that every irregularity in a reflecting surface makes the rays stray five or six times more out of their due course, than the like irregularities in a refracting one; so that a much greater niceness would be required here, than in figuring glasses for refraction: He afterwards devised a tender way of polishing, proper for metals, whereby, as he imagined, the

the figure alſo would be perfected to the laſt degree, and he began to try what might be effected in that kind, and by degrees ſo far perfected an inſtrument, that he could diſcern by it *Jupiter*'s four *Satellites*, as alſo the moon-like phaſis of *Venus*, but not very diſtinctly, nor without ſome niceneſs in diſpoſing the inſtrument; after this he made another conſiderably better than the firſt, eſpecially for day-objects; he had alſo thoughts of making a microſcope, which likewiſe ſhould have, inſtead of an object-glaſs, a reflecting piece of metal; and theſe inſtruments ſeem as capable of improvement as teleſcopes, and perhaps more, becauſe only one reflective piece of metal is requiſite in them, as appears by Fig. 4. Plate X. where A B repreſents the object-metal, C D the eye-glaſs, F their common focus, and O the other focus of the metal, in which the object is placed.

But to return, *Light* is not ſimilar or homogeneal, but conſiſts of *difform rays*, *ſome of which are more refrangible than others*; ſo that without any difference in their incidence on the ſame medium, ſome will be more refracted than others, not by any virtue of the glaſs, or other external cauſe, but from a prediſpoſition, which every particular ray hath to ſuffer a particular degree of refraction: After this he proceeds to hint at a more notable difformity in the rays of light, wherein the origin of colours is unfolded, and that doctrine is comprehended and illuſtrated in the following propoſitions.

1. As the rays of light differ in degrees of refrangibility, ſo they alſo differ in their diſpoſition to exhibit this or that particular colour; colours are not qualities of light, derived from refractions or reflexions of natural bodies, as it is generally thought, but original and connate properties, which in different rays are different; ſome rays are diſpoſed to exhibit a red colour and no other, ſome a yellow and no other, ſome a green and no other, and ſo of the reſt; nor are there only proper and particular rays to the more eminent colours, but even to all their intermediate gradations.

2. To the ſame degree of refrangibility ever belongs the ſame colour, and to the ſame colour always belongs the ſame degree of refrangibility: The leaſt refrangible rays are all diſpoſed to exhibit a red colour, and on the contrary the rays diſpoſed to exhibit a red colour, are all the leaſt refrangible; ſo the moſt refrangible rays are all diſpoſed to exhibit a deep violet-colour, and on the contrary ſuch as are apt to exhibit a violet-colour, are all the moſt refrangible; and thus to all the intermediate colours in a continued ſeries belong intermediate degrees of refrangibility:

And this analogy between colours and refrangibility is very precise and strict, the rays always either exactly agreeing or proportionably disagreeing in both.

3. The species of colour, and degree of refrangibility proper to any particular sort of rays, are not mutable by refraction or reflection from natural bodies, nor by any other cause: When any one sort of rays has been well separated from those of other kinds, it has afterwards obstinately retained its colour, notwithstanding the utmost endeavours to change it, by refracting it with prisms, and reflecting it with bodies, which in day-light were of other colours, by intercepting it by that coloured film of air between two compressed plates of glass, and by transmitting it thro' coloured mediums, and thro' mediums irradiated with other sorts of rays and differently terminating it, and yet no new colour could be produced; by contracting or dilating it, it would become brisker or fainter, and by the loss of many rays, in some cases become very obscure and dark, but it was never changed in species.

4. Yet seeming transmutations of colours may be made, where there is any mixture of different sorts of rays; for in such mixtures, the component colours appear not, but by their mutual mixture constitute a mean colour; and therefore, if by refraction or any other of the aforesaid causes, the difform rays, latent in such a mixture, be separated, there shall emerge colours different from the colour of the composition; which colours are not new generated, but only made apparent by being separated; for if they are again entirely mixed, and blended together, they will compose the same colour, they did before separation; and for the same reason, transmutations made by the union of different colours are not real; for when the difform rays are again severed, they will exhibit the very same colours, which they did before they entred the composition; as blue and yellow powders when finely mixt, appear green to the naked eye, and yet the colours of the component corpuscles are not thereby really transmuted, but only blended; for when viewed with a good microscope, they still appear blue and yellow interspersedly.

5. There are therefore two sorts of colours; the one original and simple, the other compounded of these: The original or primary colours are, red, yellow, green, blue, and a violet-purple, together with orange, indico, and an indefinite variety of intermediate gradations.

6. The same colours in species with these primary colours may also be produced by composition; for a mixture of yellow and blue makes green, of red and yellow makes orange, of orange and

and yellowiſh green makes yellow; and in general, if any two colours be mixt, which in the ſeries of thoſe generated by the priſm are not too far diſtant from each other, they by their mutual mixture produce that colour, which in the ſaid ſeries appears in the middle between them; but ſuch as are ſituated at too great a diſtance have not the ſame effect; orange and indico produce not the intermediate green, nor ſcarlet and green the intermediate yellow.

7. But the moſt ſurpriſing compoſition is that of whiteneſs, there is no one ſort of rays which alone can exhibit it, it is ever compounded, and all the foreſaid primary colours, mixed in a due proportion, are requiſite to its compoſition; for all the colours of the priſm being made to converge, and thereby become again mixed, as they were in the light before its incidence on the priſm, re-produce light intirely and perfectly white, and not at all ſenſibly differing from the direct light of the ſun, unleſs the glaſſes be not ſufficiently clear, for then they make it incline a little to their own colour.

8. Hence therefore it comes to paſs, that whiteneſs is the uſual colour of light; for light is a confuſed aggregate of rays endued with all ſorts of colours, as they are promiſcuouſly darted from the various parts of luminous bodies; and of ſuch a confuſed aggregate, whiteneſs is generated; if there be a due proportion of the ingredients; but if any one be predominant, the light muſt incline to that colour, as it happens in the blue flame of brimſtone, the yellow flame of a candle, and the various colours of the fixed ſtars.

9. Theſe things being conſidered, the manner how colours are produced by the priſm, is evident; for, of the rays conſtituting the incident light, ſince ſuch as differ in colour proportionably differ in refrangibility; they by their unequal refractions muſt be ſevered and diſperſed into an oblong form in an orderly ſucceſſion from the leaſt refracted ſcarlet to the moſt refracted violet; and for the ſame reaſon it is, that objects, when viewed thro' a priſm appear coloured; for, the difform rays, by their unequal refractions, are made to diverge towards ſeveral parts of the *Retina*, and there expreſs the images of things coloured, as in the former caſe they did the ſun's image on a wall; and by this inequality of refractions they become not only coloured, but alſo very confuſed and indiſtinct.

10. Why the colours of the rain-bow appear in falling drops of rain, is hence likewiſe evident; for thoſe drops, which refract the rays, diſpoſed to appear purple, in greateſt quantity to the

the ſpectator's eye, refract the rays of other ſorts ſo much leſs, as to make them paſs beſide it; and ſuch are the drops on the inſide of the primary bow, and on the outſide of the ſecondary or exterior one; ſo the drops that refract in the greateſt plenty the rays that are apt to appear red towards the ſpectator's eye, refract thoſe of other ſorts ſo much leſs, as to make them paſs beſide it, and ſuch are the drops on the exterior part of the primary, and interior part of the ſecondary bow.

11. The odd phænomenon of an infuſion of *Lignum Nephriticum*, leaf-gold, fragments of coloured glaſs, and ſome other tranſparently coloured bodies, appearing in one poſition of one colour, and of another in another, as may be ſeen in a dark room, by illuminating them with ſimilar or uncompounded light, are on theſe grounds no longer riddles; for, then they appear of that colour only, with which they are illuminated, but yet in one poſition more vivid and luminous than in another, according as they are diſpoſed more or leſs to reflect or tranſmit the incident colour.

12. From hence alſo appears the reaſon of an unexpected experiment Dr. *Hook* made with two wedge-like tranſparent veſſels, filled the one with red, the other with a blue liquor; *viz.* that tho' they were ſeverally tranſparent enough, yet both together became opake, for if one tranſmitted only red, and the other only blue, no rays could paſs thro' both.

13. To conclude with this general inſtance, the colours of all natural bodies have no other origin than this, that they are variouſly qualified to reflect one ſort of light in greater plenty than another, and this appeared by illuminating in a dark room theſe bodies with uncompounded light of different colours; for by that means any body may be made to appear of any colour; there they have no appropriated colour, but appear always of the colour of the light caſt upon them, but yet with this difference, that they are moſt briſk and vivid in the light of their own day-light colour: *Minium* appears there indifferently of any colour, with which it is illuminated, but moſt luminous in red, and ſo *Biſe* appears indifferently of any colour, but moſt luminous in blue; and therefore *Minium* reflects rays of any colour, but moſt copiouſly thoſe endued with red, and conſequently when illuminated by day-light, that is, with all ſorts of rays promiſcuouſly blended, thoſe endued with red will abound moſt in the reflected light, and by their prevalence cauſe it to appear of that colour; and for the ſame reaſon, *Biſe* reflecting blue moſt copiouſly, will appear blue by the exceſs of thoſe rays in its reflected light, and the

the like of other bodies: And that this is the entire and adequate cauſe of their colours, is manifeſt becauſe they have no power to change the colours of any ſort of rays incident a-part, but put on all colours indifferently, with which they are enlightned.

Theſe things being ſo, it can no longer be diſputed, whether there be colours in the dark, nor whether they be the qualities of the objects we ſee, no, nor perhaps, whether light be a body: For, ſince colours are the qualities of light, having its rays for its intire and immediate ſubject, how can we think thoſe rays to be alſo qualities, unleſs one quality may be the ſubject of, and ſuſtain another; which in effect is to call it ſubſtance: We ſhould not know bodies to be ſubſtances were it not for their ſenſible qualities, and the principal of thoſe being now found due to ſomething elſe, we have as good reaſon to believe that to be likewiſe a ſubſtance: Beſides, whoever thought any quality to be a heterogeneous aggregate, ſuch as light is diſcovered to be; but, to determine more abſolutely, what light is, after what manner refracted, and by what modes or actions it produces in our minds the phantaſms of colours, is not ſo eaſy.

The diſcourſe itſelf will lead to ſeveral experiments ſufficient for its examination, one of which is as follows.

In a darkened room make a hole in a window-ſhutter, whoſe diameter may conveniently be about $\frac{1}{3}$ of an inch, in order to admit a ſufficient quantity of the ſun's light, let a clear and colourleſs priſm be placed there, to refract the entring light towards the further part of the room, which, as was ſaid, will thereby be diffuſed into an oblong coloured image; then place a lens of about three foot radius, ſuppoſe a broad object-glaſs of a three foot teleſcope, at the diſtance of about four or five foot from thence, thro' which all thoſe colours may be tranſmitted at once, and made by its refraction to unite at a further diſtance, as of about 10 or 12 foot; if at that diſtance you intercept this light with a ſheet of white paper, you will ſee the colours converted into whiteneſs again by being mingled together: But it is requiſite that the priſm and lens be placed ſteady, and that the paper, on which the colours are caſt, be moved to and fro; for, by ſuch motion, you will not only find at what diſtance the whiteneſs is moſt perfect, but alſo ſee, how the colours gradually meet and vaniſh into whiteneſs, and after croſſing each other at the place where they compound whiteneſs, again diſſipated and ſevered, and in an inverted order retain the ſame colours, which they had before they entred the compoſition; you may alſo ſee, that if

any

any of the colours at the lens be intercepted, the whiteneſs will be changed into the other colours; and therefore that the compoſition of whiteneſs may be perfect, care muſt be taken, that none of the colours fall beſide the lens.

In Fig. 5. Plate X. A B C expreſſes the priſm ſet end-wiſe to ſight, cloſe by the hole F of the window E G; its vertical angle A C B may conveniently be about 60°; M N deſigns the lens, whoſe breadth is two ½ or three inches; S F one of the ſtraight lines, in which difform rays may be conceived to flow ſucceſſively from the ſun; F P and F R two of thoſe rays unequally refracted, which the lens cauſes to converge towards Q, and after decuſſation to diverge again; and H I the paper at different diſtances, on which the colours are projected, in Q conſtituting whiteneſs, but they are red and yellow in R, *r* and ϱ, and blue and purple in P, *p* and Π.

If you proceed further to try the impoſſibility of changing any uncompounded colour, it is requiſite the room be made very dark, leaſt any ſcattering light mixing with the colour, diſturb and allay it, and render it compounded, contrary to the deſign of the experiment; it is alſo requiſite, that there be a more perfect ſeparation of the colours, than can be made by the refraction of one ſingle priſm, and how to make ſuch further ſeparations, will ſcarce be difficult to ſuch who conſider the diſcovered laws of refractions: But if trials ſhould be made with colours not thoroughly ſeparated, there muſt be changes allowed proportionable to the mixture; thus if compound yellow light fall upon blue *Biſe*, the *Biſe* will not appear perfectly yellow, but rather green; becauſe there are in the yellow mixture many rays indued with green, and green being leſs remote from the uſual blue colour of *Biſe* than yellow, is the more copiouſly reflected by it.

In like manner, if any of the priſmatic colours, ſuppoſe red, be intercepted, with deſign to try the impoſſibility of re-producing that colour out of the others which are omitted, it is neceſſary either that the colours be very well ſeparated, before the red be intercepted, or that together with the red the neighbouring colours, into which any red is ſecretly diſperſed, as the yellow, and perhaps the green too, be intercepted, or elſe, that allowance be made for the emerging of ſo much red out of the yellow-green, as may poſſibly have been diffuſed, and ſcatteringly blended in thoſe colours; and if theſe things be obſerved, the new production of red, or any intercepted colour will be found impoſſible.

A new

A new Catadioptrical Telefcope; *by Mr.* Ifaac Newton. Phil. Tranf. N° 81, p. 4004.

THIS new inftrument is compofed of two *Metallic Specula* or mirrors, the one concave, inftead of an object-glafs, the other plane; as alfo of a fmall plano-convex eye-glafs: The tube of this telefcope is open at the end which refpects the object, and the other end is clofe, where the faid concave is placed, and near the open end is a flat oval *Speculum*, made as fmall as poffible, the lefs to obftruct the entrance of the rays of light, and inclined towards the upper part of the tube, where is a fmall hole furnifhed with the faid eye-glafs; fo that the rays coming from the object, do firft fall on the concave placed at the bottom of the tubes, and are thence reflected towards the other end of it, where they meet with the flat *Speculum*, obliquely pofited, by the reflexion of which they are directed to the little plano-convex glafs, and fo to the fpectator's eye, who looking downwards fees the object, to which the telefcope is turned.

In Fig. 6. Plate X. A B is the concave *Speculum*, whofe radius is 12 $\frac{1}{2}$ or 13 inches; CD another metallic *Speculum*, whofe furface is flat and circumference oval; GD an iron-wire holding a ring of brafs, in which the *Speculum* CD is fixed; F a fmall eye-glafs flat above, and convex below of the 12th part of an inch radius, if not lefs; for as much as the metal collects the fun's rays at 6 $\frac{1}{3}$ inches diftance, and the eye-glafs at lefs than $\frac{1}{6}$ of an inch diftance from its vertex; GGG the fore-part of the tube faftened to a brafs ring HI, to keep it immoveable; PQKL the hind-part of the tube faftened to another brafs ring PQ; O an iron-hook faftened to the ring PQ, and furnifh'd with a fcrew N, thereby to draw forwards or backwards the hinder part of the tube, and fo by that means to put the *Specula* at their due diftances; MQGI a crooked iron fuftaining the tube, and faftened by the nail R to the ball and focket S, whereby the tube may be turned every way; the centre of the flat *Speculum* CD muft be placed in the fame point of the tube's axis, where the perpendicular to this axis falls, drawn to the fame from the centre of the little eye-glafs, which point is here marked at T; and to make the reader underftand in what degree it reprefents things diftinct and free from colours, and to know the aperture by which it admits light, he may compare the diftances of the focus E from the vertex's of the little eye-glafs and the concave *Speculum*; that is,

is, E F, $\frac{1}{6}$ of an inch, E T U 6 $\frac{1}{3}$ inches; and the ratio will be found as 1 to 38, whereby it appears, that the objects will be magnified about 38 times; and be repreſented bigger by two $\frac{1}{2}$ times in diameter, when ſeen thro' this, than thro' an ordinary teleſcope of about two foot long.

Thus far as to the ſtructure of the teleſcope; as to the metallic matter, fit for theſe reflecting *Specula*, he gives this caution, that if we would have a white, hard and durable metallic compoſition, we ſhould avoid chuſing ſuch as is full of ſmall pores, diſcoverable only by a microſcope; for, tho' ſuch metal may to appearance take a good poliſh, yet the edges of thoſe ſmall pores will wear away faſter in the poliſhing than the other parts of the metal; and ſo, however the metal ſeem poliſhed yet it will not reflect with ſuch an accurate regularity as it ought to do: Thus tin-glaſs mixt with ordinary bell-metal makes it whiter and apter to reflect a greater quantity of light, but withal, its fumes raiſed in the fuſion, like ſo many aerial bubbles, fill the metal full of thoſe microſcopical pores; but white arſenic both blanches the metal and leaves it ſolid without any ſuch pores, eſpecially if the fuſion has not been too violent: What the *Stellate Regulus* of *Mars*, or rather ſuch like ſubſtances will do, deſerves particular examination; to this he adds this for their intimation, that putty or other ſuch like powder with which it is poliſhed, do, by the ſharp angles of its particles, fret the metal, if it be not very fine, and fills it full of ſmall holes: But having not tried many propotions of the arſenic and metal, he does not affirm which is abſolutely beſt, but thinks, there may conveniently be uſed any quantity of arſenic equalling in weight between a ſixth and eigth part of the copper, a greater proportion making the metal brittle; his method was this, he firſt melted the copper by itſelf, and then he put in the arſenic, which being melted, he ſtirred them a little together, obſerving not to draw in breath near the pernicious fumes; after this he put in tin and as ſoon as that was melted, he ſtirred them well together, and immediately poured them off: And he could not tell, whether their letting them ſtand longer on the fire after the tin was melted, a higher degree of fuſion would have made the metal porous, but he thought his own way the ſafeſt: He adds, that in the metal he ſent to *London*, there was no arſenic, but a ſmall proportion of ſilver, and as he remembers, one ſhilling in three ounces of metal; but he thought the ſilver did as much harm in making the metal ſoft, and ſo leſs

fit

fit to be poliſhed, as good in rendring it white and luminous: At another time he mixed *Arſenic*, one ounce, copper, ſix ounces, and tin, two ounces, and this an acquaintance of his poliſhed better than he did the other: As to the objection, that with this kind of proſpectives, the objects are found with difficulty; he anſwers, that this is an inconvenience common to all tubes that magnify much, and that after a little uſe, it will grow more eaſy, ſeeing he could readily enough find any day-objects, by knowing which way they were poſited; but in the night-time to find ſtars, he owns is more troubleſome; which yet he thinks may eaſily be remedied by two ſights affixed to the iron rod, by which the tube is ſuſtained, or by any ordinary proſpective-glaſs faſtened to the ſame frame with the tube, and directed towards the ſame object, as *Des Cartes* in his dioptrics has deſcribed for remedying the ſame inconvenience of his beſt teleſcopes.

M. *Huygens* approved of this teleſcope, and obſerved that Mr. *Newton* had well conſidered the advantages of a concave *Speculum* above convex glaſſes in collecting the parallel rays, which according to calculation M. *Huygens* found very great; hence it is that a far greater aperture may be given to that *Speculum*, than to an object-glaſs of the ſame focal diſtance, and conſequently that he can much more magnify objects this way than by an ordinary teleſcope; beſides, by it, is avoided an inconvenience, inſeparable from convex object-glaſſes which is the obliquity of both their ſurfaces, which vitiates the refraction of the rays paſſing towards the ſides of the glaſs, and does more hurt than men are aware of: Again, by the mere reflection of the metallic *Speculum* there are not ſo many rays loſt, as in glaſſes, which reflect a conſiderable quantity by each of their ſurfaces, and beſides intercept many of them by the obſcurity of their matter.

Mean time, the main buſineſs will be to find a fit matter for this *Speculum* that will bear ſo good a poliſh as glaſſes, and a way of giving this poliſh without vitiating the ſpherical figure; and he found no *Specula* that had near ſo good a poliſh as glaſs, and he thinks if a way be not found out to poliſh better, reflecting teleſcopes will not ſo well diſtinguiſh objects as thoſe with glaſſes; but it is worth while, ſays he, to ſearch for a remedy to this inconvenience, and he deſpairs not of finding one; and he believes that Mr. *Newton* had conſidered the advantages of a parabolical *Speculum* above a ſpherical one, but that he deſpaired of working other ſurfaces than ſpherical ones with a due

exactneſs, tho' otherwiſe it be eaſier to make a parabolical than elliptical or hyperbolical one, by reaſon of a property of the parabolic conoid, *viz.* that all the ſections parallel to the axis make the ſame parabola; but tho' Mr. *Newton* deſpaired of performing that work by geometrical rules, yet he doubted not but the thing might in ſome meaſure be accompliſhed by mechanical devices.

A further Account of the Reflecting Teleſcope, *with a Table of* Apertures *and* Charges *for its ſeveral Lengths; by Mr.* Iſaac Newton. Phil. Tranſ. N° 82. p. 4032.

THE aperture of this teleſcope was 1 ⅓ of an inch, it being found that an obſtacle of that breadth could intercept all the light, which came from one point of the object: He alſo found that more light was loſt by reflexion of the metal he had hitherto uſed than by tranſmiſſion thro' glaſſes; for which reaſon, he thought, a ſhallower charge would probably do better for obſcure objects, ſuppoſe ſuch a one, as would make it magnify 34 or 32 times; but as for bright objects at any diſtance, it ſeems capable of magnifying 38 or 40 times with ſufficient diſtinctneſs, and he thinks the ſame charge may with advantage be allowed for all objects, if the ſteely matter, imployed at *London*, be more ſtrongly reflective than the metal he uſed.

The effects of one of theſe inſtruments of any length, being known, it will appear by the following table, what may be expected from thoſe of other lengths: In the firſt column is expreſſed the length of the teleſcope in feet, which doubled, gives the ſemi-diameter of the ſphere, on which the concave metal is to be ground; in the ſecond column are the proportions of the apertures for thoſe ſeveral lengths; and in the third column, the proportions of the charges, or diameter of the ſpheres, on which the convex ſurface of the eye-glaſſes are to be ground.

Lengths.	Apertures.	Charges.	Lengths.	Apertures.	Charges.
½	100	100	8	800	200
1	168	119	10	946	211
2	283	141	12	1084	221
3	383	157	16	1345	238
4	476	168	20	1591	251
5	562	178	24	1824	263
6	645	186			

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The uſe of this table will beſt appear by an example; ſuppoſe therefore a half foot teleſcope may diſtinctly magnify 30 times with an inch aperture, and it being required to know, what ought to be the analogous conſtitution and performance of a four foot teleſcope; by the ſecond column, as 100 to 476, ſo are the apertures, as alſo the number of times they magnify; and conſequently ſince the half foot tube hath an inch aperture, and magnifies 30 times; a four foot tube ſhould have proportionally 4 $\frac{76}{100}$ inches aperture, and magnify 143 times; and by the third column, as 100 to 168, ſo are their charges; and therefore, if the diameter of the convexity of the eye-glaſs, for a half foot teleſcope, be $\frac{1}{5}$ of an inch, that for a four foot ſhould be $\frac{168}{500}$, that is, about $\frac{1}{3}$ of an inch: In like manner, if a half foot teleſcope can diſtinctly magnify 36 times with 1 $\frac{1}{4}$ of an inch aperture, a four foot teleſcope ſhould with equal diſtinctneſs magnify 171 times with 6 inches aperture; and one of 6 foot ſhould magnify 232 times with 8 $\frac{2}{3}$ inches aperture, and ſo of other lengths; but what the event will really be, muſt be determined by experience; only it was thought fit to give this hint, that ſuch who intend to make trials in other lengths, may more readily know how to deſign their inſtruments; thus, for a four foot tube, ſince the aperture ſhould be 5 or 6 inches, there will be required a piece of metal 7 or 8 inches broad at leaſt, becauſe the figure will ſcarcely be true to the edges; and the thickneſs of the metal muſt be proportional to the breadth, leaſt it bend in the grinding: After poliſhing the metals, trials may be made with ſeveral eye-glaſſes, to find what charge may with beſt advantage be made uſe of.

The advantage of reflexion in the theory muſt be allowed to be very great, when we conſider the different refrangibility of the ſeveral rays of light; and as for the practical part, it is in ſome meaſure evident by the inſtruments already made, to what degree of vivacity and brightneſs a metallic ſubſtance may be poliſhed; nor is it improbable, but new ways of poliſhing metal may be found out, far excelling thoſe in uſe; and when a metal is once well poliſhed, it will be a long while preſerved from tarniſhing, if it be kept dry and cloſe ſhut up from air; for the principal cauſe of tarniſhing ſeems to be, the condenſing of moiſture on its poliſhed ſurface, which by an acid ſpirit, with which the atmoſphere is impregnated, corrodes and ruſts it; or at leaſt, at its exhaling leaves it covered over with a thin ſkin, conſiſting partly of an earthy ſediment of that

moiſture, and partly of the duſt, which flying too and fro in the air, had ſettled and adhered to it: When there is not occaſion to make frequent uſe of the inſtrument, there may be other ways to preſerve the metal for a long time; as perhaps by immerging it in ſpirit of wine, or ſome other convenient liquor; and if it chance to tarniſh, its poliſh may be recovered by rubbing it with a ſoft piece of leather, or other tender ſubſtance, without the aſſiſtance of any fretting powders, unleſs it happen to be ruſty, for then it muſt be new poliſhed. As metal reflects leſs light than glaſs tranſmits, to remedy that inconvenience, a ſhallower charge than is uſed in other teleſcopes, in proportion to the aperture is to be aſſigned; but as he found ſome metallic ſubſtances to be more ſtrongly reflective, and to poliſh better, and be freer from tarniſhing than others, ſo he hoped there may in time be found out ſome ſubſtance much freer from theſe inconveniences than any yet known.

A Comet; *by M.* Hevelius, *Mr.* Iſaac Newton, *and M.* Caſſini. Phil. Tranſ. N° 81. p. 4017, *and* N° 82. p. 4042.

MArch, *N. S.* 1671, there was obſerved a new comet, tho' but ſmall, with a train not above a degree or a degree and a half long; *March* 9th, it was about the ſtars in the right arm of *Andromeda* on her ſhoulder blade; as far as M. *Hevelius* could collect from one or two obſervations, it tended towards the *Lucida* of *Andromeda*'s girdle, and that with a direct diurnal motion of about 2°. *March* 6th, in the evening 7 h. 40 m. it was in 7° *Aries*, and in 35° of N. Lat. as he gueſſed by the haſty inſpection of a globe. *March* 7th, in the morning 3 h. 30 m. its longitude was about 8° *Aries*, with a ſomewhat leſſer latitude than before; in the evening of the ſame day, its longit. was 10° *Aries*, and lat. almoſt 34°. *March* 8th, in the morning 4 h. the longit. was 12° *Aries*, and the lat. 33°, which he would not have to be taken preciſely, becauſe he could not reduce his obſervations to a calculus.

Mr. *Newton*, about *March* 16th, *O. S.* ſaw a dull ſtar, ſouth-weſt of *Perſeus*, which he took to be this comet; it was very ſmall, and had not any viſible tail.

The mathematicians of *la Flèche*, perceived the comet from *March* 16th, *N. S.* and gave the firſt hint of it at *Paris*; thoſe of the college of *Clermont* ſaw it *March* 25th. *March* 26th, 7 h. 30 m. in the evening, M. *Caſſini* ſaw it between the head

of

of *Medusa* and the *Pleiades*; without a telescope it appeared no bigger than a star of the third magnitude; its head, seen with a telescope of 17 foot, appeared almost round, but well defined and distinguished from the mistiness, which formed a kind of chevelure, or bush of hair, with which it was encompassed, and the middle was a little confused, and seemed to have such inequalities, as are seen in clouds: The tail, which is principally that which distinguishes comets from stars, was almost imperceptible, yet by the telescope it was seen turned opposite to the sun, and appeared of about the length of two diameters of the head; for it was not easy to measure it precisely, because being thinner as it was farther from the head, its extremity was insensibly lost; and so the whole comet, head, tail, and chevelure, took up no more than 3 or 4 m. of a degree: At 7 h. 48 m. it was in a straight line with the *Lucida* in the head of *Medusa*, and with the most westerly star of the *Pleiades*, and above the two clearest stars of the southern foot of *Perseus*; so that a straight line, drawn thro' these two stars, did almost touch the southern extremity of his chevelure: This place of the comet, transferred upon the map of the fixt stars, fell precisely enough upon 23° 25′ of *Taurus*, in 14° of N. Lat. With a telescope of 3 foot, two small stars, which are not in the catalogues, were seen near the comet, at the distance of the sun's diameter from each other: The comet was in a straight line, drawn from one of these two stars to the other, precisely at 9 h. 15′, but a little nearer the western one; at 9 h. 33′ it was equally distant from both, and from 8 h. 5′ till 10 h. 26′, it made an oblique motion in respect of these two stars, going from north to south, at the same time that it advanced from west to east. *March* 28th, 7 h. 42′ in the evening, the comet was distant from the less bright star of the south foot of *Perseus*, no more than about 24′ westward, having almost the same latitude with this star, so that it was precisely enough at 26° 88′, and in latitude 12° 8′; at 8 h. 14′, the distance of the comet from the star in the eye of *Taurus*, called *Aldebaran*, was found 19° 38′, and 8 h. 29′; its distance from *Capella* was found 22° 32′. *March* 30th, 9 h. 35′ at night, the comet, seen without a telescope, appeared no bigger than a star of the fourth magnitude; thro' a telescope, it exceeded those of the first; yet it was very obscure, and in what manner soever it was viewed, no tail could be observed; it had passed a degree and a half beneath the *Lucida* of the southern foot of *Perseus*; so that this star was exactly in the

the middle, between the comet and the ſmall ſtar of the leg of *Perſeus*, marked η by *Bayerus*, which then was not ſeen without a teleſcope; a ſtraight line drawn from one of theſe ſtars to the other, did almoſt touch the ſouthern limb of the comet, which being transferred on the map of the fixt ſtars, fell on 28° 45′ of *Taurus*, in N. Lat. of 9° 56′. At 9 h. 45′, the weſtern limb of the comet touched a ſtraight line, drawn thro' this leſs bright ſtar of *Perſeus*'s ſouth foot, and thro' the moſt northerly of the head of *Taurus*; only he was already got ſomewhat nearer to the latter. *March* 31ſt, 8 h. in the evening, the comet was in a direct line with the *Lucida* in the foot of *Perſeus*, and with the moſt northerly in the head of *Taurus*, but it was at more than twice the diſtance from the firſt, than from the other; and being transferred on the map of the fixt ſtars, was found at 15′ from *Gemini*, in latitude 8° 49′: During all the time of the obſervation that night, which was till 10 o'clock, it continued in this ſtraight line, which was almoſt parallel to the horizon, notwithſtanding its own particular motion ſhould raiſe him a little above it, as the parallax, on the contrary, ſhould ſink the comet beneath it in approaching the horizon. *April* 1ſt, it was found to have paſſed 45′ beyond the moſt northerly ſtar of the head of *Taurus*, to have touched it with its ſouthern limb, and to be diſtant 1° 43′ from the ſtar neareſt the ſouthermoſt, which is equally bright, yet not marked by *Bayerus*; this place being transferred upon the map of the fixt ſtars, it was found at 1° 30′ of *Gemini* in N. Lat. of 7° 44′. *April* 2d, 8 h. in the evening, it was 2° ½ diſtant from the moſt northerly ſtar of *Taurus*, and 1° from the ſtar of the ear, marked φ by *Bayerus*, and by *Tycho* called *Sequentis lateris borei*; two lines drawn from the moſt northerly ſtar of *Taurus*, one to the comet, the other to the ſtar wanting in *Bayerus* made a right angle, and the diſtance of the comet, from this angle, was double the diſtance between theſe two ſtars; this place, transferred upon the map of the fixt ſtars, fell on 2° 48′ of *Gemini* in N. Lat. of 6° 40′. *April* 3d, 9 h. the comet had paſſed over the upper ſtar of the ear of *Taurus*, making with this ſtar the baſis of an iſoſceles triangle, on whoſe top was the inferior ſtar of the ear; the two ſides of this triangle, were two and a half times bigger than the baſis, ſo that the comet was at 4° from *Gemini* in N. Lat. of 5° 38′. *April* 5th, 8 h. in the evening, the comet had paſſed the northern ear of *Taurus*, and was equally diſtant from the upper ſtar

ſtar of the north ear, and from that on the front of *Taurus*; it was alſo as far diſtant from the inferior ſtar of the ear of *Taurus*, as this ſtar is from the firſt weſtward, by *Tycho* called *Inferior præcedentis lateris quadrilateri*; and a ſtraight line, drawn thro' the comet and the upper ſtar of the ear, made almoſt a right angle with another line, drawn from the comet to the inferior of the two ſtars above the eye of *Taurus*; and transferring this place to the map of the fixt ſtars, the comet was found at 6° 18′ of *Gemini* in N. Lat. of 3° 41′; it was ſo confuſed this night, that with a teleſcope of 17 foot, the head could not be exactly diſtinguiſhed from the chevelure; the whole appeared a little bigger than *Jupiter*'s diſk, ſeen thro' the ſame teleſcope. *April* 6th, 8 h. in the evening, a ſtraight line drawn from the comet to the ſtar in the front of *Taurus*, made a right angle, with another ſtraight line drawn from the ſame ſtar, to the inferior of the two ſtars above the eye; and the diſtance of this latter ſtar from that of the front of *Taurus*, was twice the diſtance of the ſame ſtar of the front from the comet; and transferring this place upon the map of the fixt ſtars, the comet was found at 7° 25′ of *Gemini* in N. Lat. of 2° 45′. At 9 h. 6′, a ſtar ſufficiently clear was ſeen on the ſide of the comet, at the diſtance of a little more than the comet's diameter, and at the ſame altitude. *April* 7th, 9 h. in the evening, the comet was equally diſtant from the inferior ſtar of the north ear of *Taurus*, and from the ſuperior of the root of the northern horn; it was alſo as far diſtant from this latter ſtar, as this ſtar is from that of the front; and transferring this place to the map of the fixt ſtars, it fell on 8° 30′ of *Gemini* in N. Lat. of 1° 56′.

All the obſerved places of the comet, fell into a line that differed little from an arch of a great circle, cutting the ecliptic in 10° 45′ of *Gemini*, and conſequently having its greateſt latitude in 10° 45′ of *Piſces*, which is between 39 and 40° to the north; the ſame circle did cut the equator at 101° of the vernal ſection eaſtward, and its greateſt declination from the equator to the north was 38° $\frac{1}{2}$: Having choſen two of the firſt obſervations, and taken a mean between the firſt obſervations of the mathematicians of *la Flèche*, it was found, that this comet was in its *Perigæum March* 12th, at 8 o'clock in the morning; that in that time, which was that of its greateſt apparent celerity, it made about 2° 32′ a-day in the great circle of its apparent motion, and $\frac{444}{10330}$ of its *Perigæum* diſtance in the line of its equal motion; that it was in its greateſt declination the

the 11th and 12th of *March*, and that then it paſſed thro' the inferior meridian about 2 o'clock after midnight. If the *Perigæum* of the comet be rightly determined, and the hypotheſis of the equality of its motion be juſt for that time, and if it did not begin to appear till it was ſufficiently near the earth, it has been viſible ſince the middle of *February*, when it was as far diſtant from its *Perigæum*, by approaching to the earth, as it is at preſent by receding from it; it muſt then have been at the extremity of the ſouthern wing of the *Swan*, and arrived at the ſouthern foot of *Pegaſus* on the 23d of *February*, of the ſame bigneſs that it was ſeen to be of *March* 28th; it muſt have arrived at the ſtars of the northern arm of *Andromeda*, *March* 9th, at thoſe of her girdle the 12th, when it was in its *Perigæum*, and greateſt declination; to her ſouthern leg *March* 15th, between her ſouthern leg and the triangle *March* 18th, very near as the comet was obſerved at *la Flêche*, and under the head of *Meduſa*, *March* 25; the enſuing days it muſt have arrived at the places marked in the firſt obſervations; but in the laſt, it has been ſwifter than this hypotheſis will bear; to repreſent theſe latter obſervations, the line of the motion ſhould have been made curve, as was done for the end of the apparent motion of the comet of 1665, with this difference, that whereas that line was convex in regard of the earth, becauſe the motion was retrograde, this was to be made concave towards the earth, becauſe the motion of the comet was direct: It is worth obſerving, that this comet kept its courſe almoſt like that of 1665, and another of 1577, obſerved by *Tycho*; for they have paſſed thro' almoſt the ſame conſtellations, tho' this be more inclined northward, and cut the ecliptic at 5 or 6° more forward than that of 1665; ſo that it ſeems, that in this place of the heavens, there is, as it were, a zodiac for comets.

A Catadioptrical Teleſcope; *by M.* Caſſegrain. Phil. Tranſ. N° 83. p. 4056.

M. *Caſſegrain* has communicated a teleſcope of his own invention, almoſt like Mr. *Newton*'s, its deſcription is as follows; A B C D Plate X. Fig. 7. is a ſtrong tube, in whoſe bottom is a great concave *Speculum* C D, perforated in the middle E; F is a convex *Speculum*, ſo diſpoſed, as to its convexity, that it reflects the ſpecies, which it receives from the great *Speculum*, towards the hole E, where is an eye-glaſs, for one to look thro'; the advantage of this inſtrument above Mr. *Newton*'s, is, 1. That the mouth or aperture A B of the tube

tube may be of what bignefs you pleafe; and confequently you may have many more rays fall upon the concave *Speculum*. 2. The reflexion of the rays will be very natural, fince made upon the axis itfelf, and confequently more vivid. 3. The vifion will be fo much the more pleafing, in that you will not be incommoded by the great light, the bottom CD hiding the whole face; befides that you will have lefs difficulty in difcovering the object, than in that of Mr. *Newton*'s.

Mr. *Newton* confidering this inftrument, found thefe difadvantages in it, *viz*. 1. That more light will be loft in the metal by reflexion from the little convex *Speculum*, than from the oval plane; for it is an obvious obfervation, that light is moft copioufly reflected from any fubftance, when its incidence is moft oblique. 2. The convex *Speculum* will not reflect the rays fo truly as the oval plane, unlefs it be of an hyperbolical figure; which is incomparably more difficult to form than a plane; and if truly formed, yet it would only reflect thofe rays, which refpect the axis. 3. The errors of the faid convex will be much augmented by the too great diftance, thro' which the rays reflected from it, muft pafs before their arrival at the eye-glafs; for which reafon he found it convenient to make the tube no wider than is neceffary, that the eye-glafs may be placed as near to the oval plane, as is poffible, without obftructing any ufeful light in its paffage to the object-metal. 4. The errors of the object-metal will be more augmented by reflexion from the convex than from the plane, becaufe of the inclination or deflexion of the convex on all fides from the points, on which every ray ought to be incident. 5. For thefe reafons an extraordinary exactnefs is requifite in the figure of the little convex, whereas he found by experience, that it is much more difficult to communicate an exact figure to fuch fmall pieces of metal, than to fuch as are greater. 6. Becaufe the errors at the perimeter of the concave object-metal, caufed by the fphericity of its figure, are much augmented by the convex, it will not with diftinctnefs bear fo large an aperture, as in the other conftruction. 7. Becaufe the little convex conduces very much to the magnifying virtue of the inftrument, which the oval plane does not; it will magnify much more in proportion to the fphere, on which the great concave is ground, than in the other defign; and fo magnifying objects, much more than it ought to do in proportion to its aperture, it muft reprefent them very obfcure and dark; and not only fo, but alfo confufed by reafon of its being overcharged; nor is there

any convenient remedy for this; for if the little convex be made of a larger ſphere, that will cauſe a greater inconveniency, by intercepting too many of the beſt rays; or, if the charge of the eye-glaſs be made ſo much ſhallower, as is neceſſary, the angle of viſion will thereby become ſo little, that it will be very difficult and troubleſome to find an object, and of that object, when found, only a very ſmall part will be ſeen at once: From whence it is plain, that the three advantages M. *Caſſegrain* propoſes to himſelf, are rather diſadvantages; for according to his deſign, the aperture of the inſtrument will be but ſmall, the object dark and confuſed, and alſo difficult to be found; nor does he ſee why the reflexion is more upon the ſame axis, and ſo more natural in one caſe than in the other; ſince the axis itſelf is reflected towards the eye by the oval plane, and the eye may be defended from external light, as well at the ſide as at the bottom of the tube. Mr. *Gregory*, in his *Optica promota*, printed 1663, had deſcribed an inſtrument like that of M. *Caſſegrain*'s, and cauſed one of 6 foot to be made by Mr. *Reive*, probably according to the deſign deſcribed in his book, yet without any ſucceſs, tho' made by a ſkilful artiſt.

Some Experiments propoſed in Relation to Mr. Newton's Theory *of* Light. Phil. Tranſ. N° 83. p. 4059.

1. TO contract the ſun-beams without the hole of the window, and to place the priſm between the focus of the lens and the hole.

2. To cover over both ends of the priſm with paper, at ſeveral diſtances from the middle; or with moveable rings, to ſee how that will vary or divide the length of the figure, inſiſted upon in the ſaid theory.

3. To move the priſm ſo, as the end may turn about, the middle being ſteady.

4. To move the priſm by ſhoving it, till firſt the one ſide, then the middle, and then the other ſide paſs over the hole, obſerving the ſame paralleliſm.

As to the firſt experiment Mr. *Newton* obſerved, that the ſolar image falling on a paper placed at the focus of the lens, was by the interpoſed priſm drawn out in length proportionably to the priſm's refraction or diſtance from that focus; and what was chiefly obſervable here, was that the ſtraight edges of the oblong image were diſtincter than they would have been without the lens: And conſidering, that the rays coming from the planet *Venus*, are much leſs inclined to each other, than thoſe

thoſe which come from the oppoſite parts of the ſun's diſk, he once tried an experiment or two with her light; and to make it ſufficiently ſtrong, he found it neceſſary to collect it firſt by a broad lens; and then interpoſing a priſm between the lens and its focus, at ſuch a diſtance that all the light might paſs thro' the priſm, he found the focus, which before appeared like a lucid point, to be drawn out into a long ſplendid line by the priſm's refraction.

As to the ſecond experiment, he occaſionally obſerved, that by covering both ends of the priſm with paper at ſeveral diſtances from the middle, the breadth of the ſolar image would be increaſed or diminiſhed as much, as is the aperture of the priſm, without any variation of the length; or, if the aperture be augmented on all ſides, the image on all ſides would be ſo much, and no more augmented.

As to the third experiment, if one priſm alone be turned about, the coloured image will only be tranſlated from place to place, deſcribing a circle or ſome other conic ſection on the wall on which it is projected, without ſuffering any alteration in its ſhape, unleſs ſuch as may ariſe from the obliquity of the wall, or caſual change of the priſm's obliquity to the ſun's rays.

As to the fourth experiment, light paſſing thro' parts of the priſm of different thickneſſes, ſtill exhibited the ſame phænomena.

A Stone *cut out from under the Tongue*; *by Dr.* Liſter. Phil. Tranſ. N° 83. p. 4062.

THE patient, from whom this ſtone was cut, had about eight years before been taken with a great cold in a winter voyage, after which he felt a *Nodus* or hard lump in the place whence the ſtone was cut out; and ever afterwards, when he took cold, he felt great pain in that part, but after the cold was over, that part was no more painful than the reſt of his mouth; in the 7th and 8th year, it often cauſed ſudden ſwellings in all the glands about the mouth and throat upon the firſt draught of beer at meals, which would fall again in a little time; at laſt it cauſed ſudden vertigo's, which continued from ſpring to *Auguſt*, when the part ſwelled ſuddenly, and diſcharged purulent matter at the aperture of the *Ductus Whartonianus*, which ſuddenly ſtopped by cold, and ſwelled with a great inflammation, it alſo threatened ſuffocation, accompanied with incredible pain when he ventured to ſwallow, even beer or any liquid thing; and thus he continued for five days, in which

time he had ſo great a flux of ſpittle, as if he had taken ſome mercurial medicine: The firſt day the *Saliva* ran thin and tranſparent, almoſt like water, and without any bubbles; the ſecond day, it ran frothy, and it taſted ſalt, which yet he thought rather hot than really ſalt, becauſe then the inflammation was at the height; the third day it was exceeding ropy, and a ſmall pin-hole broke directly over the place of the ſtone, and diſcharged purulent matter, as formerly; the fourth day, the *Saliva* ran inſipid, ſenſibly cold in the mouth, and a little frothy; the fifth day, which was the day of the inciſion, it ran as on the fourth, leaving an extreme clammineſs on the teeth, inſomuch that they often ſtuck together, as if glued.

Upon the inciſion, which proved not wide enough, the membranes or bags, wherein the ſtone lay, came firſt away; the ſtone itſelf was ſo hard as to endure the *Forceps* in drawing it out; it was covered over with a graſſy green matter, which ſoon dried, and left the ſtone of a whitiſh colour; it was light in proportion to its bulk, weighing about ſeven grains, and much of the ſhape of an ordinary horſe-bean; there were viſible impreſſions on it of ſome capillary veſſels, it was rough and ſand-like, altho' the ſubſtance was tophaceous: This tumour was in reality, only one of thoſe tumours called *Atheroma*, and therefore the ſtone may be called *Lapis Atheromatis*.

Of Hair-Worms; *by Dr.* Liſter. Phil. Tranſ. N° 83. p. 4064.

IT has been credibly reported, that horſe-hairs thrown into water will be animated, but from unqueſtionable obſervations it appears, that ſuch things as are vulgarly thought animated hairs, are real inſects, bred within the bodies of other animals, as *Ichneumons* in caterpillars: *Aldrovandus* has collected many particulars of this animal, and he thinks it to have been unknown to the ancients; it is called by the moderns *Seta aquatica*, or *Vermis Setarius*, either from the ſlender figure of its body, or becauſe it is thought to be generated of a horſe-hair putrifying in water; others again have imagined, that they ſprung from the weeds hanging down from the banks into ponds and rivers, and others from locuſts and graſhoppers.

Dr. *Liſter* obſerved, upon throwing up the ground of his garden, a certain coal-black beetle of a middle ſize, and flat ſhape, and which he obſerved elſewhere common enough; upon diſſecting them, he found in their bellies hair-worms, in ſome

ſome three, in others only one, which upon inciſion crawled forth of themſelves; putting them into water, they lived many days in it, and ſeemed to endeavour to eſcape, by lifting up their heads out of the water, and faſtening them to the ſides of the veſſel, and very plainly drawing the reſt of their body forwards; he is of opinion, that they cannot be ſaid to be *Amphisbæna*, that is, with a head at each extremity, and going both ways, for the head is plainly diſtinguiſhable from the tail, by a notable blackneſs; the three he took out of the body of a beetle, were all of a dark hair colour with whitiſh bellies, ſomewhat thicker than horſe-briſtles; but he took out of the body of another beetle one much thicker, of a lighter colour, and meaſuring juſt five inches and a half in length, whereas all the reſt did not exceed 3 ¾ inches.

Perſons *ſuppoſed to be ſtung by* Tarantula's; *by Dr.* Tho. Cornelio. Phil. Tranſ. N° 83. p. 4066.

IN the country of *Otranto*, where *Tarantula*'s are very numerous, a certain perſon, fancying himſelf ſtung by a *Tarantula*, ſhewed a ſmall ſpeck in his neck, about which, in a little time, ſome pimples broke out full of a ſerous humour, and in a few hours after, he was very much afflicted with violent ſymptoms, as ſyncope's, great agitations, giddineſs of the head, and vomiting, but without any inclination to dance, or deſire of having any muſical inſtruments; he died in a miſerable condition in two days: All thoſe who fancy themſelves bitten by *Tarantula*'s, are generally young wanton girls, called by the *Italian* writers *Dolci di Sale*, who by ſome particular indiſpoſition falling into this melancholly madneſs, perſwade themſelves, according to the vulgar prejudice, to have been ſtung by a *Tarantula:* There is a terrible diſorder often obſerved in *Calabria*, and called *Coccio maligno*, it ariſes on the ſurface of the body, in the form of a ſmall ſpeck, as big as a lupin; it cauſes ſome pain, and if it does not grow ſoon red, in a little time it infallibly kills; it is commonly thought, that this diſorder only affects thoſe that have eaten the fleſh of animals that die of themſelves; which opinion, might from experience be ſhewn to be falſe: And thus it is very common, that ſuch ſtrange effects, whoſe true cauſe is unknown, are aſcribed to ſuch cauſes as are grounded on ſome vulgar prejudice.

Of the Baths *at* Aponum; *by Mr.* Dodington. Phil. Tranſ. N° 83. p. 4067.

FIVE miles from *Padua* are the waters called *Aponenſia*, from *Aponum* a town famous in antiquity, and frequently mentioned by *Livy:* The waters are actually very hot, and ſtinking, and yield a great deal of very fine ſalt, which the natives ordinarily uſe, and it is gathered in this manner; the natives, after ſun-ſet, ſtir pieces of wood in the water, and preſently the ſalt ſticks to them, and comes off in ſmall flakes, exceeding white and very ſalt, this ſalt never loſes its ſavour; with this water the inhabitants waſh their walls white, which it does in a manner far exceeding lime; theſe walls retain their ſaltneſs only a few days, and afterwards become inſipid, tho' they ſweat forth a white excreſcence in thin and light flakes, like nitre, for many years after; but the ſalt collected from the ſtones, gravel and earth, thro' which the rivulets that fall from thoſe baths, do run, is entirely inſipid, tho' it differ in nothing as to form or colour from that which is gathered with wooden ſticks.

An Inland Sea *near* Dantzick *yielding in Summer a poiſonous Subſtance*; *by* Mr. Kirby. Phil. Tranſ. N° 83. p. 4069.

NEAR a ſmall village, called *Tuckham*, 2 ½ *German* miles from *Dantzick*, is an *Inland Sea*, made by the meeting of three rivulets, ſome ſprings from the adjoining hillocks, and the deſcending rain and ſnow-water, of about ½ a *German* mile long and ⅛ broad: The ſoil round about ſeems to be ſand mixt with clay; its ſhore is generally ſandy, as is alſo the bottom; its depth where deepeſt, four fathom, and generally in other places one or one and a half; it is ſtored with wholeſome and delicate fiſh, as pearch, roach, eels, &c. and famed for a ſmall fiſh, much eſteemed there, and reſembling a pearch, only not ſo party-coloured, having a larger head, proportionable to its body, called the *Cole-pearch*; the water is ſweet and wholeſome, only in the three ſummer months, *viz. June*, *July* and *Auguſt*, it turns, during the dry weather, green in the middle, with a hairy efflorefcence; which green ſubſtance, forced violently a-ſhore by the wind, and ſwallowed with the water by any cattle, dog or poultry, cauſes certain and ſudden death; yet horſes are obſerved to be unhurt by it, and the water that runs from it in the ſtreams is wholeſome.

Animad-

Animadverſions *on Mr.* Newton's *Theory of* Light; *by the R. F.* Ign. Gaſton Pardies. Phil. Tranſ. N° 84. p. 4087. *Tranſlated from the* Latin.

IT ſeems a thing extraordinary that light, according to the learned author, ſhould conſiſt of almoſt an infinite number of rays, which have a natural diſpoſition of exhibiting and retaining their own proper colours, and are fitted in a certain and peculiar manner to be refracted, ſome in a greater and others in a leſs degree; and that theſe rays, which, while promiſcuouſly blended together in open day-light, are undiſtinguiſhable, and exhibit a white colour, ſhould notwithſtanding in refraction have rays of one colour ſeparated from thoſe of all others, and thus ſeparated, appear in their proper and native colours; and that ſuch bodies ſhould appear of a certain colour, for inſtance, red, which are fit to reflect or tranſmit rays of that colour only.

This extraordinary hypotheſis, which overturns the whole baſis of dioptricks and renders uſeleſs the practice hitherto known, is entirely founded on the experiment of the priſm, in which rays entring into a darkened room thro' a hole in the window, and then falling on a wall, or received on a paper, did not form a round figure, as he expected according to the received rules of refraction, but appeared extended into an oblong form; whence he concluded, that this oblong figure was owing to the different refrangibility of the rays of light.

But according to *F. Pardies* the figure of the rays ſhould be oblong and not round, even by the commonly received laws of dioptricks; for ſince rays proceeding from oppoſite parts of the ſolar diſk are variouſly inclined to the priſm in their paſſage, they ſhould likewiſe be variouſly refracted; as when the inclination of ſome rays is at leaſt 30′ greater than that of others, their refraction muſt alſo be proportionably greater: Therefore oppoſite rays emerging from the ſecond ſurface of the priſm become more diverging, than if they had proceeded without any, or at leaſt with an equable refraction: The refraction of the rays happens only towards thoſe parts, which may be ſuppoſed to be in planes perpendicular to the axis of the priſm, for there is no inequality of refraction towards thoſe parts, which are ſuppoſed to be in planes parallel to the axis, as may be eaſily demonſtrated, for the two ſurfaces of a priſm may be conſidered as parallel, with reſpect to the inclination of the axis, ſince they are both parallel to it, and a refraction

refraction thro' two parallel plane surfaces is held for none, because, by as much as a ray is refracted one way by the first surface, by so much is it refracted by the second the contrary way; therefore since the rays of the sun transmitted from a hole thro' a prism are not refracted on the sides, they proceed as if no prism at all stood in their way, he means, if we regard only the lateral divarication, but when the same rays on the superior and inferior parts, are some more, or some less refracted, as being inequally inclined, their divergency must be greater, and consequently the rays must be extended into an oblong figure: And if a proper calculation were made, he doubts not, but as the lateral rays were found of a breadth that subtended an arch of 31′, which answers to the sun's diameter, so likewise the length of the image which subtended 2° 49′ would correspond with the same diameter after the unequal refractions; and supposing a prism A B C Fig. 8 Plate X. whose angle A is 60°, and a ray D E making with the perpendicular E H an angle of 30°, after emerging in the line F G, it forms with the perpendicular F I an angle of 76° 22′; but supposing another ray *d* E which forms with the perpendicular E H an angle of 29° 30′, after emersion thro' the line *fg* it constitutes with the perpendicular *fi*, an angle of 78° 45′; whence the two rays D E, and *d* E supposed to proceed from opposite parts of the solar disk, and to form an angle of 30′, the same rays after emersion in the lines F*g*, *fg* diverge in such a manner as to constitute an angle of 2° 23′; and if two other rays were assumed approaching nearer the perpendicular E H, as suppose one of them form an angle of 29° 30′, and the other 29°, these rays after emersion would diverge still more and constitute a greater angle, even sometimes exceeding one of 3°; and besides, this distance between the refracted rays is further encreased, arising from this, that the two rays D E, *d* E meeting in E, begin immediately to diverge and fall on two distant points of the second surface, *viz.* in F and *f*: Wherefore, in order to render the calculation just, it is not sufficient to subduct the diameter of the hole from the length of the image, for supposing the hole E indivisible, yet a great hole would, as it were, be formed in the second surface of the prism, *viz.* F*f*.

What the author calls the *Experimentum Crucis* seems likewise to agree with the commonly received laws of refraction, for, as was just now shewn, the rays of the sun, which approaching and converging form an angle of 30′, do afterwards, coming out behind an indivisible hole, diverge into an angle of 2° or 3°;

or 3°; wherefore it is not to be wondered at, if theſe rays falling ſeverally on a ſecond priſm, and having a very ſmall hole in it, be unequally refracted, ſeeing their inclination is unequal; nor does it alter the caſe, that theſe rays are raiſed or depreſſed by the converſion of the firſt priſm, while the ſecond remains immoveable, which yet cannot be done in all caſes, or that the firſt continuing immoveable, the ſecond be moved, that it may ſucceſſively receive the coloured rays of the whole image, and tranſmit them thro' its proper hole; for in either caſe it is neceſſary that the extreme rays, as the red and violet fall on the ſecond priſm under an unequal angle, and conſequently their refraction be unequal, and that of the violet be the greater.

Since then there is an evident cauſe of that oblong figure of the rays, and ſuch a one as ariſes from the very nature of refraction, it ſeems needleſs to have recourſe to another hypotheſis, or admit of that different refrangibility of rays.

His notion of colours flows extremely well from his foregoing hypotheſis, yet it is not without its difficulties, for when he ſays, that the ſeveral rays being promiſcuouſly blended together, yield no colour but rather appear white, this does not ſeem conformable to the ſeveral phænomena; for certainly the ſame variations that are ſeen in the mixture of divers bodies of different colours, are alſo obſerved in the mixture of different rays of different colours; and he himſelf has well obſerved, that as a green colour ariſes from a yellow and blue body, ſo likewiſe a green colour is produced from a yellow and blue ray; wherefore if the ſeveral rays of the ſeveral colours ſhould be blended together, according to that hypotheſis it is neceſſary that that colour ſhould appear, which in reality diſcovers itſelf upon mixing together the ſeveral ſorts of painters colours, as red, yellow, blue, purple, &c. which produce not a white but an obſcure ſated colour, and conſequently ordinary light would appear of the like colour, as being an aggregate of all ſorts of colours.

Nothing can be more ingenious than his ſolution of Dr. *Hook*'s experiment, in which are two different liquors, the one red, the other blue, and each a-part tranſparent, yet when mixed together they become opake, which the illuſtrious author thus explains, that one liquor is diſpoſed to tranſmit red rays only, the other only yellow, whence both being mixed together they will tranſmit none: But it ſhould ſeem that the

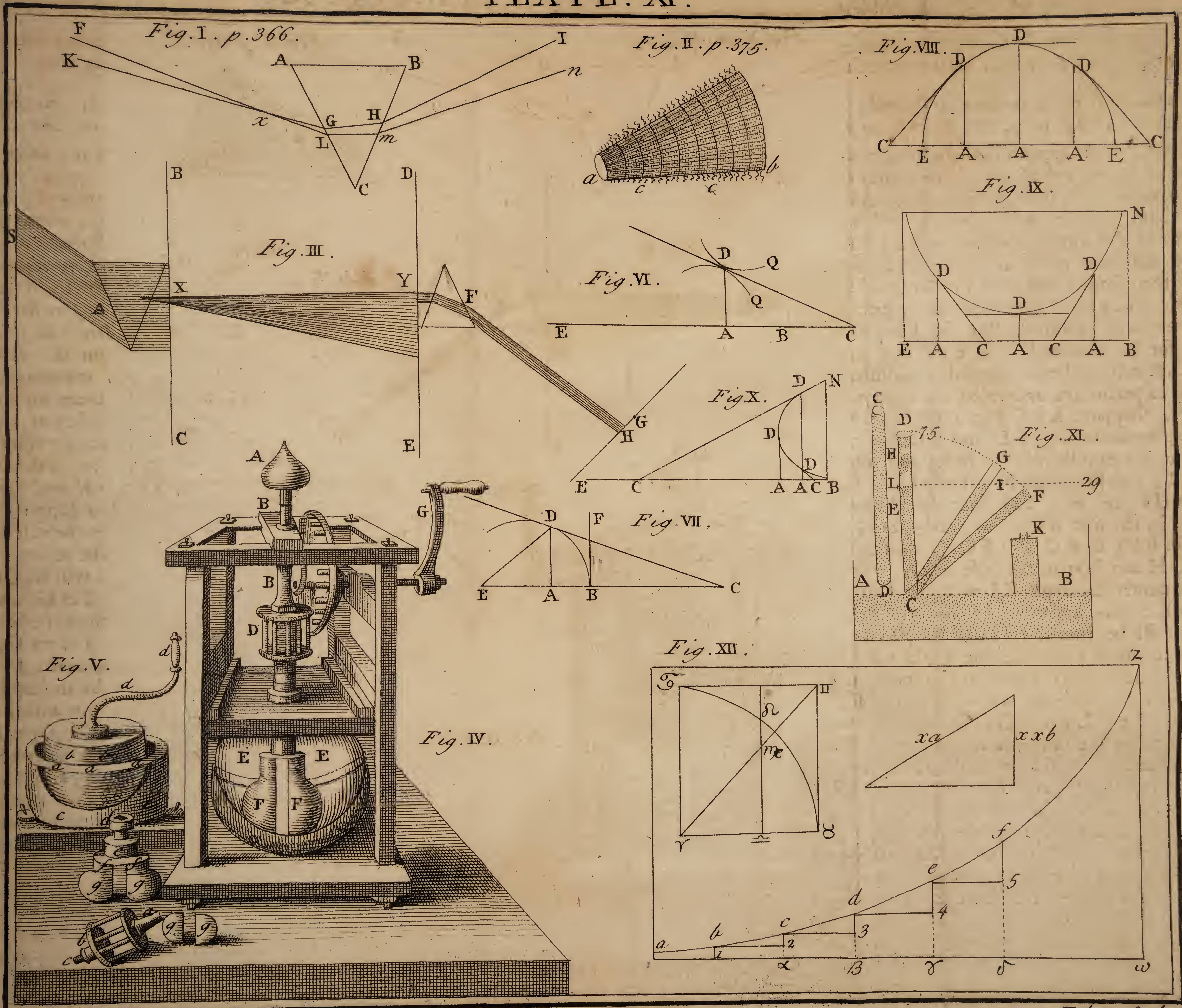
like opacity ſhould ariſe from the mixture of any other liquors of different colours, which yet is far from being true.

The preceeding Animadverſions *anſwered*; *by* Mr. Newton. Phil. Tranſ. N° 84. p. 4091. *Tranſlated from the* Latin.

IG. *Pardies* is of opinion that the length of the ſolar image produced by the refraction of the priſm requires no other cauſe to account for it than the different incidence of the rays from oppoſite parts of the ſun's diſk, and that conſequently that length of the image does not prove a different refrangibility of the different rays; and to confirm this, he produces a caſe, in which from a different incidence of 30′ the difference of refraction may be 2° 23′ or ſomething greater, as Mr. *Newton*'s experiment requires. But the Rev. Father is under a miſtake, for he has made the refractions from the different parts of the priſm to be as unequal as poſſible, whereas the author in his experiments and calculations upon them uſed equal refractions. Suppoſe A B C Fig. 1. Pl. XI. a ſection of a priſm perpendicular to its axis, F L and K G two rays croſſing each other in *x* the middle of the hole, and falling on that priſm at G and L, and let them be refracted into G H and L *m* and again into H I and *m n*; and ſince Mr. *Newton* ſuppoſed the refractions in the ſide A C to be nearly equal to the refractions in the ſide B C; if A C and B C be equal, the inclination of the rays G H and L *m* to the baſe of the priſm will be ſimilar, and conſequently the angle C L *m* = the angle C H G, and the angle C *m* L = the angle C G H; wherefore the refractions in G and *m* will be likewiſe equal, as alſo in L and H; and therefore the angle K G A = the angle *n m* B, and the angle F L A = the angle B H I, and conſequently the inclination of the refracted rays H I and *m n* will be the ſame with that of the incident rays F L and K G: Let therefore the angle F *x* K of 30′ be equal to the ſun's diameter, the angle comprehended between H I and *m n* will be alſo of 30′, providing the rays F L and K G be equally refrangible; but by trial that angle was found about 2° 49′ conſtituted by the ray H I exhibiting the extreme violet colour, and by the ray *n m*, yielding a blue; and conſequently theſe rays were differently refrangible, or the refractions were neceſſarily produced according to the unequal ratio of the ſines of incidence and refraction.

The Rev. Father further adds, that to make a juſt calculation it is not ſufficient to ſubſtract the diameter of the hole from

PLATE. XI.



G. S. del. Hulett Sculp.

from the length of the image on the paper, ſince, if we ſuppoſe the hole to be indiviſible, yet there would be formed as it were a broad hole in the poſterior ſurface of the priſm: Notwithſtanding this, Mr. *Newton* thinks that the refractions of rays croſſing each other both in the anterior and poſterior ſurfaces of the priſm may be juſtly calculated from his principles; but if the caſe were otherwiſe, the breadth of the hole in the poſterior ſurface would not cauſe a miſtake of two ſeconds, and in practice ſuch niceties may be overlooked.

And what the Rev. Father contends, is not inconſiſtent with the *Experimentum Crucis*, *viz.* that the unequal refractions of rays endued with different colours were produced by unequal incidences; for tranſmitting rays thro' two very ſmall immoveable holes and at a diſtance from each other, the incidences, as Mr. *Newton* made the experiment, were intirely equal, and yet the refractions were manifeſtly unequal.

It is objected to the theory of colours, that powders mixt of divers colours exhibit an obſcure and duſky colour and not a white one; according to Mr. *Newton*, white, black and all the intermediate duſky colours, which may be compounded of mixtures of white and black, do not differ as to their ſpecies, but as to their quantity of light; and ſeeing in the mixing of painters colours, each corpuſcle reflects only its own proper colour, and conſequently the greateſt part of the incident light is ſuppreſſed and retained; the reflected light will become obſcure, and as it were mixed with darkneſs, ſo that it will exhibit a duſky colour and not an intenſe whiteneſs.

Again it is objected, that an opacity ſhould equally ariſe from a mixture of any liquors of different colours in the ſame veſſel, as from the ſame liquors contained in different veſſels, which he ſays is falſe; but there is no conſequence in this, as Mr. *Newton* obſerves, for many liquors act mutually on each other, and acquire a new texture of parts, whence they may become opake, diaphanous, or of various colours, in no manner owing to the colours of the compound; and on that account ſuch experiments are not ſo very proper to draw concluſions from them; and let it be obſerved that liquors of ſated and intenſe colours are requiſite in this experiment, which tranſmit very few rays but thoſe of their own colours, ſuch as rarely occur, as will be ſeen by illuminating liquors with the different colours of the priſm in a darkened room; for few will be found appearing diaphanous enough in their own proper colours, and opake in thoſe of other bodies; beſides it is proper

 that

that the colours uſed be oppoſite, ſuch as he takes red and blue to be, yellow and violet, or green, and that purple which comes near to ſcarlet; and poſſibly ſome of theſe liquors mixed together, whoſe tinging parts do not coaleſce, will become more opake; but the experiment is plainer in liquors a-part, which, as well as the phænomena of the *Iris*, the tincture of *Lignum Nephriticum* and other natural bodies, was advanced to illuſtrate not prove this doctrine.

He takes in a friendly part F. *Pardies*'s liberty in calling his theory an hypotheſis, ſeeing he was not acquainted with it: But the author's deſign was quite different, for it ſeems to contain nothing other than certain properties of light, which once diſcovered may be eaſily proved, and which if he did not take to be true, he would rather have them rejected as vain and empty ſpeculation than acknowledged even as an hypotheſis.

Of a Stone *found in the Bladder of a* Dog, *and another faſtened to the Back-bone of a* Horſe. Phil. Tranſ. N° 84. p. 4094.

THE dog was a ſpaniel, two palms and a half high, and an excellent ſetter for quails, he would burſt, rather than make urine or dung in the place he was kept; by reaſon of his aptneſs to bite, he was cut at five years old, and two years after that he began to make urine with much difficulty; but as ſoon as he was let looſe, he would run preſently into the garden and fall to eating of pellitory of the wall, and fig-leaves, which *Matthiolus* and others obſerve to provoke urine and cleanſe the reins: This diſorder continued upon him for five years together, ſometimes with that violence, that his maſter had him ſyringed and anointed with oil of ſcorpions, together with other remedies to relieve the poor creature; at length he died at 12 years old, and there was found in his bladder, upon opening him, a ſtone weighing an ounce, of an irregular figure, and white, yet here and there ſome reddiſh ſpecks; and in the bottom of the bladder was found a great deal of ſmall white gravel, and in the mouth of the *Urethra* a ſtone as big as a great pine-kernel, white and tender; the reſt of the body was all ſwelled.

The other ſtone, that was faſtened to the back-bone of a *Spaniſh* gelding, about 13 or 14 years old, was extraordinary big, and weighed four pounds, was of a roundiſh figure, a little flatted, its longeſt diameter being five inches, and its

ſhorteſt

ſhorteſt four, it was of an olive colour, but a little inclining to a brown, with red ſpecks, reſembling coagulated blood, and radiated circularly with black and white veins and waves; but the reſt of it ſo delicately poliſhed, that it reflected the images of the objects about it; it was wrapped up in a membrane full of fat, and faſtened at both ends to the back-bone, over againſt the kidneys; tho' the horſe had been dead 12 hours and quite cold before he was opened, yet the ſtone was ſtill very warm, and retained a conſiderable heat for ſix hours after it was taken out.

The genuine Method of Examining the Theory *of* Light *and* Colours; *by* Mr. Newton. Phil. Tranſ. N° 85. p. 5004.

IT cannot be thought effectual for determining truth, to examine the ſeveral ways, by which phænomena may be explained, unleſs where there can be a perfect enumeration of all thoſe ways: The proper method, for inquiring into the properties of things, is, to deduce them from experiments; and the truth of this theory of light and colours was made out, not by inferring it was thus, becauſe not otherwiſe; that is, not by deducing it only from a computation of contrary ſuppoſitions, but by deriving it from experiments concluding poſitively and directly: The method therefore of examining it is, to conſider, whether the experiments do prove thoſe parts of the theory, to which they are applied; or to proſecute other experiments which the theory may ſuggeſt for its examination; and this ſhould be done in a due method, the laws of refraction being firſt thoroughly enquired into, before the nature of colours be taken into conſideration; and it may not be amiſs to proceed according to the following queries:

1. Whether rays, that are alike incident on the ſame medium, have unequal refractions; and how great the inequalities of their refractions at any incidence?

2. What is the law according to which each ray is more or leſs refracted; whether the ſame ray be ever refracted according to the ſame ratio of the ſines of incidence and refraction; and different rays, according to different ratio's, or the refraction of each ray be greater or leſs without any certain rule; that is, whether each ray have a certain degree of refrangibility, according to which it is refracted, or if refracted without that regularity?

3. Whether rays endued with particular degrees of refrangibility, when by any means ſeparated, have particular colours

lours constantly belonging to them, *viz.* the least refrangible, scarlet; the most refrangible, deep violet; the middle, sea-green; and others, other colours? and on the contrary;

4. Whether the colour of any sort of rays a-part may be changed by refraction?

5. Whether colours by coalescing do really change one another to produce a new colour, or produce it by mixing only?

6. Whether a due mixture of rays, endued with all variety of colours, produces light perfectly like that of the sun, having all the same properties and exhibiting the same phænomena.

7. Whether the component colours of each mixture be really changed, or be only separated, when various colours are again produced from that mixture by refraction?

8. Whether there be any other colours produced by refraction than such as ought to result from the colours belonging to the differently refrangible rays, by their being separated or mixed by that refraction?

To determine by experiments these and such like queries, which comprehend the theory, seems the most proper and direct way to a conclusion; and therefore it were to be wished, that all objections were laid aside, taken from hypothesis, or any other heads, than these two, *viz.* of shewing the insufficiency of experiments to determine these queries, or prove any other parts of the theory, by assigning the defects in the conclusion drawn from them; or of producing other experiments directly contradictory to them; for if the experiments, which are used, be defective, it cannot be difficult to shew the defects; but if valid, then by proving the theory they must render all objections invalid.

A Communication between the Ductus Thoracicus *and the inferior* Vena Cava; *by M.* Pecquet, *with remarks by Dr.* Needham. Phil. Trans. N° 85. p. 5007.

THE discovery of the *Ductus Thoracicus* by M. *Pecquet* did not seem sufficient to clear up all the difficulties relating to sanguification: It might be said among other things, that there appears no reason why nature should carry the blood into the subclavian veins, and thence make it descend by the trunk of the *Vena Cava (a)* unless it be to prevent the chyle from entring all at once, and altogether pure, into the heart, and that the mixture which is made of the chyle with the blood might dispose it by a kind of fermentation the more easily to receive the character of the blood in the heart; and

and that this might be more conveniently done, the *Ductus Thoracicus* is inserted into that trunk of the *Vena Cava* which ascends to the heart, because this way is shorter and equally favourable to this commixture. It might also be objected, that supposing this commixture were of importance, the *Ductus Thoracicus* should communicate with the inferior trunk of the *Vena Cava*, as well as with the superior, to the end, that one half of the chyle being mixed with the blood that comes from above, and the other half with the blood that comes from below, (*b*) it might the more easily be altered by this commixture; and this objection seemed the more rational, because it being very likely that the blood, which returns from the parts, in which it has received some impression in penetrating their pores, communicates to the chyle the same dispositions; there was reason to desire, that the blood which re-ascends, might in some degree impress the peculiar character of the inferior parts, as that which comes from the upper parts impresses the character of these parts: (*c*) Add to this, that the blood which re-ascends to the heart, must be more perfect than that which descends, because it comes from being purified in the liver, spleen, and kidneys; so that it is capable to impart (*d*) good impressions to the chyle: (*e*) Lastly, it might be said, that, supposing it be necessary, that not only a proportion of the chyle pass thro' the heart, but also, that all the chyle be conveyed thither, to be converted into blood, the small orifices with which the *Ductus Thoracicus* opens into the subclavian veins, seem not to be large enough for that purpose (*f*): And the observations made on the *Ductus Thoracicus* in the body of a woman, did shew, that these difficulties were well grounded; for, it has been found by several experiments made about this matter, that there ascends at least as much chyle thro' the trunk beneath the heart, as descends thro' that which is above it: The *Ductus Thoracicus* has been found to communicate not only with the left emulgent vein, but also with the two lumbary veins, which are inserted into the trunk of the inferior *Vena Cava*, for upon injecting milk (*g*) into the emulgent thro' the left lumbary vein, it was observed to come away thro' the other lumbary: This experiment having been several times repeated without being able to see the track, which was formerly observed under the *Pleura*, (*vid.* N° 25. *p.* 461.) a more easy and certain method of discovering this branch, than the usual dissection of the vessels, was attempted; (*h*) which was to inject into the trunk of the

Ductus

Ductus Thoracicus a compoſition that might run into it hot, and upon cooling become ſolid enough, that the channels might be more eaſily traced; and this deſign ſucceeded in part, for the compoſition filled the whole *Ductus Thoracicus*, and aſcended into the ſubclavian, but nothing paſſed into the channel that makes the communication ſought for, tho' the ambient parts were warmed by ſeveral injections of milk, that the compoſition might not harden before it penetrated into all the channels; it was alſo attempted to inject the ſame compoſition thro' the lumbary that iſſues out of the trunk, if its valves would permit, but neither milk nor wind could enter: (*i*) By this injection, the figure and ſtructure of the *Ductus Thoracicus* were diſtinctly ſeen, for it was found that the *Ductus* did aſcend into the right ſide of the heart, retaining ſtill the ſame ſize, which was no more than $\frac{1}{12}$ of an inch, that afterwards it was enlarged to $\frac{1}{6}$ of an inch in diameter, that in this enlargement its tunicle on the right ſide of the *Vertebræ* was as it were, pierced with four ſmall holes, at the diſtance of $\frac{1}{12}$ of an inch from each other, and all diſpoſed in a line; and into theſe holes the compoſition could not penetrate; that the *Ductus*, after reſuming its firſt ſize, had two appendices faſhioned like ſacks; that there was a third appendix beneath the dilatation; that the firſt and higheſt appendix was of the form and bigneſs of a ſmall pea; that the third, which was beneath the dilatation, was like the ſecond, that they had a ſtreight orifice; and that the laſt was full of thick chyle, ſo that the compoſition could not enter as it had done into the other.

On all this Dr. *Needham* makes the following remarks, *viz.* (*a*) that the reaſon for inſerting the trunk of the *Ductus Thoracicus* into one place alone, is as good as any that are afterwards given to prove the contrary; for proofs of this nature are at beſt, but looſe conjectures, the matter admitting of no other demonſtration than what is ocular.

(*b*) Till the lower inſertion be ſhewn, we muſt believe that nature thought the ſingle commixture of blood and chyle ſufficient; and if there be any thing in the notion of *impreſſing Characters*, it is more attributable to the lymph, ſee note *d*.

(*c*) That the blood which re-aſcends to the heart, is purer than what deſcends from the head, &c. is a notion that will not eaſily be granted, neither can it be made out by experiment; for upon comparing the blood of the jugular vein with that of the crural in a dog, there was no obſervable difference; the

the ſecretions made by the kidneys and liver, if they prove any thing, prove the aſcending blood to be thicker than the deſcending, having loſt in thoſe places much of its *Serum* and lixivial ſalts, which are the great inſtruments of attenuation; but withal it is to be conſidered, that the blood, which aſcends from the heart to the head, loſes much of its excrementitious parts in the ſalival glands, noſtrils, and throat; there is alſo a great ſecretion made in the brain, which, whether it be of the pureſt and beſt ſpirits of the blood, ſo as to leave it depauperated, or only of a nutritious *Serum*, ſuch as is made in all the ſolid parts, is hard to determine; only this may be ſaid with certainty, that the lymph does wholly exonerate itſelf into the ſubclavian and jugular veins, near the place where the chyle is diſcharged, by which the chyle is diluted, and its mixture with the blood facilitated; which very phænomenon is a greater argument to prove, that the chyle does entirely enter by that paſſage, than any that can be produced on the other ſide; for we obſerve all the lymph, not only of the liver and inteſtines, but alſo of the inferior parts, to pour itſelf into the *Receptaculum Chyli*, and not into any of the inferior veins; and as the *Lymphatics* of the head, neck, and arms, meet with the chyle at the place of its entrance, ſo the ſame might have been done by the inferior *Lymphatics* had they any chyle to meet with there, the principal uſe of the *Lympha* ſeeming to be, to ſerve the uſes of the chyle and its mixture with the blood.

(*d*) What impreſſions are made on the blood by the liver, ſpleen, kidneys, *&c.* is uncertain, but if there be any ſuch thing, the liver and kidneys do ſo readily diſcharge themſelves into the *Vena Cava*, that the impreſſions, be they what they will, are quickly conveyed to the heart, without any great diminution of them: And whereas, the author makes mention of characters impreſſed from parts; theſe, if there are any ſuch, may more juſtly be ſuppoſed to be conveyed in the *Lympha*, which ſeems to be the reſult of a curious elaboration in thoſe parts.

(*e*) What is ſufficient, and inſufficient, muſt be judged of by nature, and not by us; yet if we conſider the time ſpent in carrying the chyle up into the blood, it is eaſy to believe, that a much greater quantity of liquor may be diſcharged by that *Ductus*, than is uſually pretended to.

(*f*) What theſe experiments are, Dr. *Needham* would be glad to know: But the experiment in N° 25. was only a *Luſus Naturæ* found out by M. *Pecquet* only, becauſe neither he nor any one

 elſe

else have obſerved it ſince; whereas the lacteals, and the ways of ordering them, are ſo well known, that if any ſuch thing were, it could not long be undiſcovered.

(*g*) An injection into the lumbary vein, only proves the inoſculation of the two lumbary veins with each other; which is acknowledged to be ſo in all the capillary veſſels of the ſame kind, *viz.* that veins communicate with veins, and arteries with arteries; but the queſtion here is, whether there be a paſſage from the *Receptaculum Chyli* to the lumbary vein, or to any other vein beſides the ſubclavian.

(*h*) The injecting a liquor, which is apt to coagulate, into the *Ductus Thoracicus*, is needleſs and unprofitable in this inquiry, when there is both a more eaſy and demonſtrative way; which is to open a dog at a convenient interval of time after feeding, and then tie a ligature on the *Ductus Thoracicus* near the ſubclavian, and the *Receptaculum* will continue full 48 hours or longer; ſo that if there were any ſuch *Ductus*, it would in a quarter of the time empty the whole receptacle; whereas, upon a ligature the contrary is found, *viz.* that all the lacteals are fully diſtended, which is a demonſtration, that they have no other way of evacuation than by the *Ductus Thoracicus.*

(*i*) Dr. *Needham* approves of the other uſe of the coagulating injection, tho' the ſame may be done by a ligature: However, the event of M. *Pecquet*'s experiment makes againſt the opinion of a new *Ductus*, and not for it.

Some further Objections againſt the Theory *of* Light *and* Colours; *by F.* Pardies. Phil. Tranſ. N° 85. p. 5012. Tranſlated from the *Latin*.

F. *Pardies* is of opinion, that the length of the image may be otherwiſe accounted for, than by the different refrangibility of the rays; for according to that hypotheſis, which *Grimaldi* explains at large, and in which light is ſuppoſed to be a certain ſubſtance every rapidly moved, the rays may be ſomewhat diffuſed after their paſſage and decuſſation in the hole: Alſo in that other hypotheſis, in which light is made to move forwards by certain undulations of a ſubtile matter, as Dr. *Hook* explains it, colours may be accounted for by a certain diffuſion and expanſion of theſe undulations, made on the ſides of the rays beyond the hole, by the influence and continuation of the ſubtile matter; ſo that theſe apparent colours are ſolely the effect of that communication of motion, which is diffuſed laterally

laterally by the direct undulations: As, if the rays entring by the hole *a* Plate XI. Fig. 2. ſhould proceed towards *b*, the undulations ſhould indeed terminate directly, in regard of their direct and natural motion, at the right line *a b*, yet notwithſtanding, on account of the continuity of the matter, there is ſome communication of the motion towards the ſides *c c*, where it becomes tremulous and undulatory; and if colours be ſuppoſed to conſiſt in that lateral undulation, all their phænomena may be explained thus; as alſo the reaſon aſſigned, why the breadth of the colours muſt be expanded beyond the divergency of the rays themſelves.

As to the *Experimentum Crucis*, F. *Pardies* does not in the leaſt doubt, but that the inclination of the incident rays was equal, ſince the author expreſly affirms it; but he inſiſts, that that could not be gathered from the account given of it; according to which there are two ſmall and very diſtant holes, as alſo a priſm near the firſt hole in the window, thro' which the coloured rays eſcape, and fall on the other diſtant hole; and it is added, the firſt priſm was turned round its axis, to make all the rays fall ſucceſſively on the ſecond hole; now the inclination of the rays, which fall on the ſecond hole, muſt neceſſarily be changed in this caſe; and F. *Pardies* hinted, that it would be the ſame thing, whether the ſecond hole were raiſed or depreſſed, for the rays to fall ſucceſſively upon it, while the firſt priſm was immoveable, or whether, the ſecond hole being immoveable, the firſt priſm were turned round, that ſo the ſame image might change its ſite, and all its parts ſucceſſively fall on the ſecond hole; but doubtleſs the ſagacious *Newton* uſed other precautions.

F. *Pardies* declares himſelf ſatisfied with the ſolutions to his objections about colours; and adds, that his calling his theory an hypotheſis was entirely without deſign, as taking up with the firſt appellation that occurred to him; wherefore he begs that it may not be thought to be done out of any diſreſpect.

The Anſwer to the foregoing Objections; *by Mr.* Newton. Phil. Tranſ. N° 85. p. 5014. Tranſlated from the *Latin.*

ONE is at a loſs to determine, whether, in theſe obſervations of the Rev. F. *Pardies*, there appear more of humanity and candour, in allowing *Anſwers* their due weight, or of penetration and genius, in ſtarting *Objections*; at leaſt, it is certain, that theſe are very neceſſary qualifications in the reſearch of truth. But to proceed, F. *Pardies* aſſerts, that the length

of the coloured image may be accounted for, without having recourſe to the different refrangibility of the rays of light; as ſuppoſe, by the hypotheſis of F. *Grimaldi*, *viz.* by a diffuſion of light, which is ſuppoſed to be a certain ſubſtance put into very rapid motion, or according to Dr. *Hook*, by a diffuſion and expanſion of an undulatory motion; which, being produced in the *Æther* by lucid bodies, is propagated every way; and to theſe may be added *Des Cartes*'s hypotheſis, in which a ſimilar diffuſion of *Conatus*, or preſſion of the globules may be imagined, after the ſame manner as in accounting for the tails of comets; and the ſame diffuſion or expanſion may be deviſed according to any other hypotheſis, in which light is ſuppoſed to be a power, action, quality, or certain ſubſtance emitted from all the parts of luminous bodies.

In anſwer to this, Mr. *Newton* obſerves, that his doctrine of refraction and colours, conſiſted only in certain properties of light, without regarding any hypotheſes, by which theſe properties might be explained; for the ſureſt and beſt method of philoſophizing ſeems to be, firſt, to inquire diligently into the properties of things, and to eſtabliſh theſe properties by experiments; and in the next place, to proceed more ſlowly to hypotheſes for their explication; for hypotheſes ſhould be ſubſervient in explaining, and not in determining the properties of things, except ſo far as they may furniſh experiments; for if the poſſibility of hypotheſes is to be the ſtandard of the truth and reality of things, all certainty muſt in that caſe be baniſhed from the world, ſince an infinite number of hypotheſes may be deviſed, which ſhall ſeem to ſupply new difficulties; wherefore it was here thought neceſſary to intirely lay them aſide, as foreign to the purpoſe, that the force of the objection ſhould be abſtractly conſidered, and that the anſwer might be more full and general.

Therefore by light, Mr. *Newton* underſtands, any being, or power of a being, (whether we ſuppoſe it a ſubſtance, or any power, action, or quality thereof) which, proceeding directly from a lucid body, is apt to excite viſion; and by the rays of light, its leaſt, or indefinitely ſmall parts, which are independent of each other, ſuch as are thoſe rays, emitted by lucid bodies, either at once or ſucceſſively in right lines; for as well the collateral as the ſucceſſive parts of light are independent, ſince ſome of the parts may be intercepted without the others, and be ſeparately reflected or refracted towards different quarters; this being premiſed, the whole force of the objection

objection lies in this, that colours may be lengthened out by ſome certain diffuſion of light beyond, the hole, which diffuſion does not ariſe from the unequal refraction of the different rays, or independent parts of light.

But that the length of the image ariſes ſolely from the different refrangibility of the rays was already proved, and to confirm the whole, the *Experimentum Crucis* was added, which is now explained by a ſcheme, *viz.* let B C Fig. 3. Pl. XI. be the anterior board, and cloſe before it, let the priſm A be fixed, let D E be the other board, at the diſtance, ſuppoſe of 12 foot, and cloſe behind it the other priſm F; and let holes be made in the boards at *x* and *y* in ſuch a manner, that ſome of the light refracted by the anterior priſm may paſs thro' both holes to the ſecond priſm, and be there refracted a ſecond time; now let the anterior priſm be turned round its axis with a reciprocal motion, and the colours falling on the poſterior board D E will be raiſed and depreſſed by turns, and thus the ſeveral colours may be at pleaſure made to paſs ſucceſſively thro' the hole *y* to the poſterior priſm, while all the other colours fall on the board; and rays of different colours will be obſerved to be differently refracted in the poſterior priſm, as will appear from their falling on different parts of the wall or obſtacle G H at the diſtance of ſome feet from it; ſuppoſe, the violet rays refracted to H, the red to G, and the intermediate rays to intermediate parts; and yet on account of the determinate poſition of the holes, the incidence of the rays of each colour thro' both muſt be ſimilar, and thus it appears by meaſuring, that rays of different colours have different laws of refractions: But F. *Pardies*'s doubt ſeems to ariſe from his placing the firſt priſm A behind the board B C, and thus turning it round its axis, it is probable that the inclination of the rays intercepted between the holes was changed on account of the intermediate refraction; but by the deſcription, the firſt board ſhould be placed behind the priſm, that the rays might lie in a ſtrait line between the holes, as appears from the words, *I took two boards, and placed one of them cloſe behind the priſm at the window*, and ſo much was hinted in doing the experiment. It may be obſerved over and above, that in this experiment the coloured light is much leſs diffuſed and leſs divergent by the refraction of the ſecond priſm, than when it is white, ſo that the image is almoſt circular at G or H, eſpecially if the priſms be parallel, and their angles in a contrary poſition, as in the figure; beſides, if the diameter of the hole *y* be equal to the breadth

of

of the colours, the coloured light will not be diffufed lengthwife, but the image formed by any colour at G or H will be entirely circular, fuppofing the holes to be circular, and the refraction of the pofterior prifm not to exceed that of the anterior, as alfo, the rays to be nearly perpendicular to the obftacle; which proves, that the diffufion, treated of above, does not arife from the influence or continuity of the undulating matter, or matter put into a fwift motion, or any fuch like caufes, but from a certain law of refraction for each fpecies of rays; why the image is in one cafe circular, and in others a little oblong, and how the diffufion of light lengthwife may in any cafe be diminifhed at pleafure, is left to the determination of geometricians, and to experience.

After that the properties of light fhall by thefe and the like experiments have been fufficiently made out, by confidering its rays either as collateral or fucceffive parts, which are found to be diftinct from their independance on each other; from thefe properties, a judgment is to be formed of the feveral different hypothefes, and fuch as are inconfiftent therewith to be rejected; but it is a very eafy thing to fit hypothefes to the prefent doctrine, for if any one would fet up as an advocate for the *Cartefian* hypothefis, he need only fay, that the globules are unequal, or that fome preffions of the globules are ftronger than others, whence they become varioufly refrangible, and apt to excite the fenfation of different colours; and thus again, according to Dr. *Hook*'s hypothefis, fome undulations of the *Æther* are larger or thicker than others, &c. But this feems to be the abfolutely neceffary law and condition in all hypothefes, *viz.* that natural bodies be fuppofed to confift of innumerable corpufcles connected together, and that from the different corpufcles of fhining bodies, or the different parts of the fame corpufcle (as they happen to differ in motion, figure, magnitude, or other qualities) unequal preffions, motions, or moved corpufcles be on all fides trajected through the *Æther*, of whofe confufed mixture light may be fuppofed to confift; and nothing can be harfher in thefe different hypothefes than the contrary fuppofition: As to that aperture or dilatation of the light, which F. *Pardies* fuppofes to refemble a hole, in the pofterior furface of the prifm, it is fufficient that the error arifing thence be very inconfiderable, if any at all; but if the calculation be made precifely according to obfervations, the error will vanifh, for fubducting the diameter of the hole from the length of the image, that length will remain, which the image would

would have, providing the hole before the prifm were indivifible, notwithftanding the dilatation of the light in the pofterior furface of the prifm, as is eafily fhewn: Again all the reft is determined from that given length of the image, and its diftance from the indivifible hole, as alfo from the pofition and figure of the prifm; and befides from the inclination of the incident rays, and from the angle, which the refracted rays tending to the middle of the image conftitute with thofe that are incident from the fun's centre: And the fame *data* that determine the refractions and pofitions of the rays are fufficient for an accurate calculation of thefe refractions; yet the thing feems not to be of fo great importance as to be much regarded.

That the Rev. Father fhould give this doctrine the appellation of hypothefis, Mr. *Newton* is perfuaded was owing to nothing more than his ufing the firft term that occurred to him, it being the cuftom to denominate all philofophical fpeculations, hypothefes; and he declares that the reafon of his excepting againft it was to prevent the prevailing of a term, that might be of prejudice to all true philofophers.

F. *Pardies*, upon this anfwer, declared himfelf fatisfied with the folutions to his objections, that his fcruple as to the *Experimentum Crucis* was entirely removed, and that he now plainly underftood that experiment by the figure.

The Caufe of the Sufpenfion of Mercury *at an unufual Height; by M.* Huygens. Phil. Tranf. N° 86. p. 5027.

THE experiment is briefly this; that a tube filled with mercury in the *Torricellian* way, and before inverfion perfectly purged of air, does, when inverted, remain topfull, even to the height of 75 inches: M. *Huygens*, to render a probable caufe of this ftrange effect, conceives, that, befides the preffure of the air, which keeps the mercury fufpended at about the height of 27 inches, there is befides another preffure, ftronger than that, of a fubtiler matter than air, which eafily penetrates glafs, water, quickfilver, and other bodies, which are impenetrable to air; and this preffure being fuperadded to that of the air, is capable of fuftaining the 75 inches of mercury, and poffibly more, as long as it only exerts its force againft the lower furface, or againft that of the mercury, in which the open end of the tube ftands; but as foon as it can exert itfelf alfo on the other fide, which happens when upon ftriking againft the tube, or admitting into it a fmall bubble of air, you give way to this matter to begin to act, its preffure

becomes

becomes equal on both sides, so that there is only the pressure of the air, which sustains the mercury at the ordinary height of 27 inches: If you ask, why the quicksilver in the tube does not feel the pressure of this matter, even whilst that vessel is yet full, since M. *Huygens* supposes, that it pierces without difficulty as well the glass as the mercury, *&c.* and why the particles of this matter do not join together and begin the pressure, in regard they pass freely thro' the whole extent of the mercury, and that the glass does not hinder their communication with those that are without? To remove this difficulty, which according to M. *Huygens* himself is very great, he answers, that tho' the parts of the subtile matter, do find a passage between the parts of the glass, quicksilver, *&c.* yet not sufficiently large for many to pass together, nor to move there with that force requisite to separate the parts of the quicksilver, that have some connection together; and this same connection, according to him, is the cause, that tho' on the side of the inner surface of the glass, which touches the suspended mercury, many of its parts be pressed by the particles of this matter; yet there being also a great number of them that feel no pressure, by reason of the parts of the glass, behind which they are placed, they sustain each other, and remain all suspended, because the pressure on the surface of the quicksilver contiguous to the glass is much less than on that below, which is all exposed to the action of that matter which produces this second pressure.

The ingenious author of this solution owns, that it does not so fully satisfy him, as not to leave some scruple behind; but then he adds, that that hinders not his being well assured of that new pressure, which he supposes besides that of the air, on account as well of the experiment already alledged, as of two others to this effect.

First, when two plates of metal or marble, whose surfaces are perfectly plane, are laid on each other, they stick so close together, that the uppermost being raised, the undermost is raised too; and the cause of this is justly ascribed to the pressure of the air against their two external surfaces: Upon taking two plates, each of them an inch square, and of that substance, of which anciently looking-glasses were made, and being laid on each other, the uppermost does not only sustain the other, but sometimes also three pounds of lead fastened to it, and thus remain joined as long as you please; upon suspending them thus in a receiver, and exhausting the air to that degree that

that there remained not ſufficient to ſuſtain by its preſſure an inch of water, yet the plates were not disjoined; he adds, he made the ſame experiment by putting ſpirit of wine between the two plates, and he found that in the exhauſted receiver, they ſuſtained, (without being disjoined) the ſame weight, they did when it was full of air; and this, he thinks, ſhews clearly enough, that there remains ſtill in the receiver a preſſure great enough, after that of the air is removed.

The ſecond experiment is to this purpoſe, that whereas the running of water in a ſyphon of unequal legs ariſes from the weight of the atmoſphere, which preſſing on the water of the veſſel makes it riſe in the ſyphon, while it deſcends by its own weight on the other ſide; M. *Huygens* found a means to make the water of the ſyphon run, after the receiver was exhauſted, which accordingly it did, as in the external air; the ſhorteſt of the legs of the ſyphon was eight inches long, and its aperture, two lines.

And this he takes for a further confirmation of his ſuppoſition of a preſſure in this matter more ſubtile than air; to which he adds, that if the degree of the force of this preſſure be enquired into, *viz.* by purſuing the experiment with tubes full of mercury, and longer than thoſe employed by Mr. *Boyle*, it will perhaps be found, that this force is great enough to cauſe the union of the parts of glaſs and other bodies, which hold too well together, not to be conjoined but by their contiguity and reſt, as *Des Cartes* would have it.

The Structure of the Lungs; *by Mr.* J. Templer. Phil. Tranſ. N° 86. p. 5031.

THE lungs appear to conſiſt of a number of veſicles complicated with blood-veſſels; for upon blowing into the *Aſpera Arteria* of fowls, the continuation of many veſicles was obſerved, to be extended from the *Bronchiæ* thro' the *Abdomen* to the *Anus*, which ſeems to be the cauſe of the conſtant motion of the *Anus* in fowls, the air having ingreſs and egreſs there, and that alſo to be the reaſon why the *Anus*'s of fowls in malignant diſtempers are applied to draw infection out of the body; and this ſtructure of the lungs ſeemed to be confirmed by blowing into the *Aſpera Arteria* of quadrupeds, after cutting off part of the exterior membrane of one lobe of the lungs; for they were found to riſe with unequal protuberances, not unlike bladders; but the following experiment hath very much ſhaken that conjecture; for making a ligature about a dog's

neck, and opening both the jugular veins with a pretty large orifice, he was let bleed to death; immediately upon opening the *Thorax*, and tying the *Vena Cava*, with all the paſſages from the left ventricle of the heart, or its auricle, the lungs with the heart and *Aſpera Arteria* were entirely cut out; and having fitted a ſyphon to the *Aſpera Arteria*, and faſtening it with a ſtrong binding of packthread, the lungs were blown up, and fitting a cork to the end of the ſyphon, they were hung in a chimney to dry; in a quarter of an hour they ſubſided about a ſixth part, but continuing to blow them up as they ſubſided, they would not next morning ſubſide a fourth part in three hours; and making a proportionable allowance for the drying of the whole ſubſtance of the lungs, there was no conſiderable ſubſiding obſerved in two days more; but upon blowing in at the ſyphon, the air was eaſily perceived to paſs thro' the external membranes, both on the convex and concave ſides, towards the extremity of the circumference of the lobes, but moſt plentifully on the concave ſide: Upon carefully cutting off one of the lobes, the internal ſtructure appeared like a cane or dried flag when cut tranſverſely; and upon blowing in at the ſyphon, the air ſeemed to come out equally at all the pores; and putting ſpittle on ſeveral parts and blowing a-freſh, a number of bubbles were ſeen; making a deep tranſverſe inciſion into that lobe, or blowing in at the ſyphon, the air came out ſo freely at the larger ramifications of the *Bronchiæ*, that the lobe could not be ſwelled with a ſtrong blaſt; but upon ſtopping with the fingers the larger paſſages of the *Bronchiæ*, it would, upon a freſh blaſt, riſe conſiderably with unequal protuberances, where the inciſion was made, not without ſome ſuſpicion of latent veſicles; after this, tying the lobe above the inciſion, and taking off part of the external membrane of another lobe, after firſt tying up all the reſt of the lobes, water was poured into the ſyphon, and it was ſtrongly blown into, in hopes to have the water come forth in ſtreams at all the pores; but that did not ſucceed to ſatisfaction, it coming out in an irregular bedewing of the external ſurface, without any ebullition, unleſs at the larger ramifications of the *Bronchiæ*; then tying up this ſecond lobe, and untying a third, and pouring in an ounce of the oil of turpentine, and giving a ſmall blaſt at the ſyphon and corking it up, two hours after the ſmall membrane of that lobe was taken off, and upon a gentle blaſt at the ſyphon, there was an ebullition of an infinite number of little bubbles: Upon cutting the lobes in pieces with various irre-

irregular incifions, there was eafily obferved the feveral ramifications of the aerial and blood-veffels, with their continuation to the circumference of the lobes, and a proportionable diminution as they were at a greater diftance from their original: Shall it hence be concluded, that the ftructure of the lungs is a complication of innumerable ramifications of the *Bronchiæ* and blood-veffels; and that the feeming veficles were occafioned only by the violence of the blaft and the drynefs of the extreme and fmalleft paffages of the aerial veffels; whereupon, thofe neareft the *Bronchiæ*, being moifter, were extended beyond their ordinary pitch, upon ftopping the free paffage of the air in the leffer veffels, or their extremities?

A Defcription of the Lake *of* Geneva. Phil. Tranf. N° 86. p. 5043.

THE lake of *Geneva*, which in fummer is one of the moft pleafant places in the world, lies like a crefcent of water, one of whofe extremities is 18 leagues diftant from the other; and its banks are gently raifed from fmall heights and hillocks, to prodigious mountains, which yet do not lie fo clofe together, but that they leave between them interftices of 15 or 20 leagues profpects, chequered with meadows, corn-fields orchards, vines, forefts of fir-trees, and fnow upon the fides of the rocks; all thefe objects which at a diftance are confounded, and feem to make but one, have near at hand their feveral beauties; the country is beautifully cut out by rivulets, which, after they have ferved to make iron, paper, &c. difcharge themfelves into the lake. That point of the crefcent on which *Geneva* is fituated is fomewhat longer than the other; this crefcent where largeft, which is from *Morges* to *Thonon*, is about five leagues over: The water of this lake is very good to drink, and always fo limpid, that even in the rolling of the waves, which fometimes are high enough, the water is not troubled, fave along the banks; and if one attentively look down from the caftle of *Chilon*, or from any of the neighbouring eminences, into the bottom of the lake, he may fee high mountains under the water; and the water is fo deep before *Veuvay*, that the founding line, at the end of 400 fathoms, feems to touch upon fomething flippery; before *Roole* it is held to be 500 fathoms deep; and it is affirmed, that near this great depth a kind of ifland may be feen under water: The *Rhone* enters at one of the points of the crefcent into the lake, and iffues out at the other; but with this difference, that

whereas it comes in dirty and miry, it always goes out ſo pure and clear, that under the bridge of *Geneva*, where the water in ſummer is 25 feet deep, you may diſcern the ſmalleſt ſtones at bottom; and the ſame water, which in this place appears of a ſapharine-blue in the ſhade of the houſes, appears altogether green, nor is it ſo tranſparent, when the ſun ſhines on it. Tho' the *Rhone* entring into the lake loſes of its rapidity, yet ſome ſenſible motion is obſerved in ſome places, and no trouts are taken any where in this lake, but in this current of the *Rhone*: The water of this lake commonly begins to encreaſe about the end of *January*, or the beginning of *February*, and continues to do ſo till the 20th of *July*, and often to the very month of *Auguſt*; and then it inſenſibly decreaſes, ſo that the water is not ſo high in winter as in ſummer, by 12 or 15 feet: It is generally thought that the melting of the ſnow and ice from the mountain ſpring, and torrents, are the principal cauſes of the water's increaſe; for when there falls much ſnow in winter, the waters are very high the enſuing ſummer; but when great rains happen in *January*, then the ſnow, not being well hardened, melts all of a ſudden; and when this melting is not ſo violent, the remaining ſnow diſſolves at the end of *May* or beginning of *June*; ſo that only the ſtock of ice remains for ſupplying the encreaſe of the water till the month of *Auguſt*; ſome have thence been induced to aſſign other cauſes, *viz.* that the herbs growing at the bottom do force the water upwards, and dying again in autumn, make the water ſink lower; but this does not ſeem to be ſatisfactory, as there are no herbs ſeen upon the lake and few within it; others are of opinion that the waters are rarified and ſwelled by the heat of the ſun; but it is certain, that all the rivers and torrents falling into this lake, carry with them ſtore of ſtones and earth, which may indeed enlarge and raiſe it; but ſuch an augmentation can only be ſenſible in a number of years; not to mention that in winter, whilſt the water is low, the ſtones of the lake are carried away for building or fortifying at *Geneva*.

At the iſſuing out of the bars, that form *Geneva* on the ſide of the lake, are ſeen in the water two or three huge flints, ſtanding out of it, the principal one is called *Niton*; and the tradition is, that it formerly was an altar conſecrated to *Neptune*, there being a place cut out in the middle, which is taken to have been the place for the ſacrifices; ſeven or eight perſons can ſit on this flint, and ſometimes when the waters are very low, there are found about it knives, and needles as thick as

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bodkins, and much longer, made of braſs, which are ſuppoſed to have been uſed in their ſacrifices.

This lake appears ſometimes in calm weather, and even before ſun-riſing, as if it conſiſted of ſeveral pieces differently coloured, and part of it is browner than the reſt, which ſeems to be cauſed by a breath of wind paſſing thro' the water, coming either from the bottom of the lake, or from above; tho' others think this gentle agitation to proceed from ſome ſprings, that are at the bottom, imparting a tremulous motion to the water above; but that part of the water that is not agitated, appears as even and ſmooth as a looking-glaſs, or like the wake of a ſhip; the colours are thought to be cauſed by the neighbouring mountains, whoſe different images being blended in the water, exhibit an appearance of very pale colours: The *Rhone* does not reſume its rapid courſe till about a quarter of a mile's diſtance from its coming out again, and the nearer it approaches *Geneva*, its bed becomes narrower, and conſequently its courſe more impetuous; yet this rapidity may be ſurmounted by wind and water, for in the winter of 1645, there aroſe in the morning, about nine o'clock, ſo violent a wind, that not only uncovered the houſes, but alſo laid bare the channel of the *Rhone* above the bridge, ſo that they paſſed over it dry-ſhod for the ſpace of an hour, when it again reſumed its former courſe; the water then happened to be low and the wind weſterly, which, being confined between high mountains, bore violently upon the water near the bars, keeping that which was beyond them ſuſpended, while the waters below them run down a declivity: *Gallaſius* in his commentary on *Exodus*, printed 1560, relates that the like accident happened at *Geneva*, when he was miniſter there; a ſouth-weſt-wind making the *Rhone* recoil into the lake, and affording a dry paſſage for the ſpace of an hour: As to the other cauſe, it is to be obſerved, that *Arve*, a kind of torrent, empties itſelf into the *Rhone*, about 1000 paces below *Geneva*; in *December*, 1652, the *Arve* ſwelled to ſuch a degree, that it not only overflowed its banks with impetuoſity, but alſo interrupted the courſe of the *Rhone*, and forced it to re-enter the lake for the ſpace of 14 hours.

The lake abounds in fiſh, and what is obſervable, theſe fiſhes have cantoned themſelves, and divided the lake amongſt them; trouts being found in the current of the *Rhone*, carps towards *Vevay*, and pikes and pearches have alſo their ſeparate habitations, but ſome other fiſhes that are only paſſengers

gers and not inhabitants of the lake, ſpread themſelves indifferently every where: The great trouts leave the lake for four months of the ſummer, and are taken in autumn on their return; the fiſhing is farmed out at *Geneva*; and there are conſervatories, where many of thoſe large trouts are kept, of which ſome weigh 50 pounds; they ſometimes catch pikes of 80 pounds, and each pound at *Geneva* is 18 ounces: In *July* and *Auguſt* they fiſh for the fry of pearches when very ſmall, and they make a delicate diſh of them, called *Mille Cantons*.

The Uſe of Digeſtion, Fermentation *and* Triture; *by Dr.* Joel Langelot. Phil. Tranſ. N° 87. p. 5052.

THIS author, in the firſt place, ſhews the uſefulneſs of *Digeſtion* in the preparation of the volatile ſalt of tartar; for he aſſures that by a long *Digeſtion*, he obtained a pure white volatile ſalt of tartar, leaving behind a few inſipid feces of an earthy colour: To this he adds, another great uſe of *Digeſtion* in duly preparing the eſſences of mineral ſulphurs, and he inſtances in an experiment made upon corals, as what moſt clearly ſhews the great power of *Digeſtion*; for digeſting in a bolt-head fragments of red coral in oil, in a month's time, the coral got a higher colour and grew ſofter, yet without any change in the oil; he therefore continued the ſame degree of heat, and after ſome days, the coral was entirely diſſolved into a very red mucilage, and yet the oil ſwimmed upon it in its priſtine form, without receiving any tincture at all; he often ſhook the veſſel ſtrongly, to make the oil unite with the mucilage of the coral; but all was in vain, the oil ſtill aſcending when the veſſel was at reſt, and the mucilage ſubſiding; on this, he tried whether he could combine them by *Digeſtion*, but that not ſucceeding, he poured off the oil, which he found to retain almoſt its former ſcent and taſte, and poured on the remaining mucilage ſome tartariſed ſpirit of wine, and by a ſhort *Digeſtion* it was reſolved into a high red tincture.

To ſhew the power and uſe of *Fermentation* in chymiſtry, he took of crude tartar, two, three, or more pounds at pleaſure, and firſt calcined it ſlightly, and only to a degree of blackneſs, to have, what is moſt neceſſary, a ferment for the tartar; putting this into a large pot, he poured water till it ſtood an inch above it; then he gave it at firſt a gentle fire to make it lukewarm, and after that he poured into it half a handful of tartar, finely pulverized, and ſhortly after he ſaw ſome bubbles ariſe, that increaſed more and more; upon which he continued to pour

pour in at ſeveral times more powder of tartar, whereby the *Fermentation* was raiſed and quickened, the bubbles riſing thereupon as regularly, as if they had been natural grapes, the colour excepted; after the *Fermentation* was over, he put all that was in the pot into an iron bolt-head, to which a wet linnen cloth was often applied, to hinder the fermented tartar from boiling up too high; upon which account alſo, the fire is to be carefully managed, and encreaſed by little and little, tho' at laſt it muſt be ſtrong to force up all the ſalt; and he found the groſs and feculent tartar ſo volatiliſed by the *Fermentation*, that there remained no fixt ſalt in the *Caput Mortuum*; he adds that the liquor obtained from thence, having much phlegm in it, is alſo to be rectified till it appear whitiſh; a proof of its containing a due quantity of volatile ſalt.

Another inſtance of the uſe of *Fermentation* appears in ſeparating impure and noxious ſulphurs, which he preſcribes to try on opium, whereby, according to him, it becomes not only a very ſafe medicine, but alſo highly uſeful in many caſes: Take then, ſays he, of true *Theban* opium ſliced, one pound, and pour upon it in a low cucurbit ten pounds of freſh juice of ripe quinces, adding to it an ounce of pure and very dry ſalt of tartar, and expoſe it to a gentle heat for a day or two, till ſome bubbles appear, which is a ſign of the approaching *Fermentation*; and then to promote it, add four ounces of ſugar finely powdered, ſtill obſerving the degree of heat requiſite in *Fermentation*; and you will obſerve the opium manifeſtly riſe, and diſſolve *per minima*, avoiding in the mean time the ſteams of the ſtrong-ſcented ſtupifying ſulphur; and then alſo a part of the impure volatile ſcum will be ſeen to emerge to the top, and the more terreſtrial to ſubſide to the bottom of the veſſel, the purer part remaining in the middle, which is a red liquor, tranſparent like a ruby, and which is carefully to be ſeparated, filtrated, and by a due diſtillation thickened to the conſiſtence of honey; and this muſt be again diſſolved with a highly rectified ſpirit of wine, filtrating and digeſting it for a month, that the crudities in it may be ripened, and brought to perfection; this ſpirit being abſtracted to a due conſiſtency, you will find this eſſence ſo efficacious, that the fourth part of a grain, or at moſt half a grain, taken in a proper vehicle, either moiſt or dry, will perform wonders.

In the third place he comes to *Trituration*, and tho' gold be the moſt fixt body that is known, which yields not to fire, or any other diſſolvent, yet it was maſtered by *Grinding*, which

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was done by means of a machine called a philoſophical mill, repreſented Plate XI. Fig. 4. A is a leaden head pretty thick; B the axis; C an indented drum; D a drum conſiſting of cogs; E a mortar; F peſtles; G a handle by which the mill is turned; *a* the upper part of the axis, which is round; *b* the lower part of the ſame, which is ſquare; *c d* are the peſtles which are affixed to the axis; *e*, the peſtles ſtrengthened by a ſtrong braſs ring; *ff*, are both peſtles ſtrengthened with two braſs caſes; *gg*, two thick peſtles of glaſs.

The operation itſelf is as follows; put leaf-gold in any quantity at pleaſure, and cut very ſmall, into a very thick glaſs-mortar, or one of gold, ſuch a one as the late king of *Denmark* cauſed to be made for this operation; in this mortar, covered only with paper, to keep out duſt, grind the ſaid gold night and day by an uninterrupted agitation of the mill, till it is reduced to a duſkiſh colour, for which operation commonly 14 days and nights are allowed; but if you work only by day, it will take up a whole month; this done, put the powder into a ſhallow retort, and drive it gently with a ſand heat, but at laſt with a very ſtrong one, and there will come over a few, but very red drops, which being digeſted either alone, or with tartariſed ſpirit of wine, make a true *Aurum potabile*, ſincere, and unmixt with any foreign quality: Of the remainder, tho' it could eaſily have been reſolved by grinding, it was thought proper to make an extract by means of a philoſophical vinegar, made of verdegreaſe, ſulphur, and a highly rectified ſpirit of wine, by a long digeſtion; whereby was obtained a tincture ſufficiently red, and of very great virtue; and the little that remained was reduced into a body by the means of borax, but it wanted its due weight: It is true, this operation, at firſt view, ſeems to be groſs, requiring much time and labour, tho' but little art; yet if well conſidered, it is highly admirable, being aſſiſted by the wonderful ſalt of the air, as the only catholic diſſolvent; and that that ſalt is by the continual grinding attracted and intermixed, appears from many experiments.

The ſecond experiment of the uſe of this *Grinding*, was in a true and genuine preparation of the mercury of antimony; the operation is this, firſt grind the regulus of antimony into an impalpable powder, and to a pound of it add two pound of very pure and dry ſalt of tartar, and three ounces of ſal-armoniac, and mix them well together, then moiſten it with the urine

urine of a healthful man, eſpecially a wine-drinker, and grind the mixture for a whole day together without any intermiſſion, always moiſtening it with urine; then put this mixture into a bolt-head, and pour urine upon it till it ſtand three inches high, and cloſing it well, keep it in digeſtion for a whole month, ſhaking it every day; and if in that time the maſs appear dry, pour on more urine; after the digeſtion is over, form the matter into globules, with equal parts of beaten glaſs and unſlacked lime, and dry it in the ſhade; of theſe extract the mercury in the following manner; pour cold water into an oblong iron veſſel, like a bolt-head, and put it into the ground, place an iron-plate with many holes upon it, and thereon lay the globules after being well dried, then fit an iron head ſomewhat flatted to it, that you may conveniently lay coals thereon, and thus keep a moderate fire for four hours, then encreaſe the fire to the laſt for as many hours; after that, let it cool, without ſtirring the veſſel put in the ground, nor pour out the water, before it be entirely cooled, elſe you will loſe a great deal of the mercury; and this mercury of antimony the author had handled with his hands, and ſeen it with his eyes after diſtillation, running in the bottom of the veſſel: To this is ſubjoined another way of grinding gold by an inſtrument deſcribed thus, *a* Plate XI. Fig. 5. is a mortar of very fine ſteel; *b* a body ſerving for a peſtle, of the ſame metal, which is to fit the mortar; *c* is a ſmall ſpace, with a golden plate interpoſed, of the thickneſs of half a ducat; *d* the handle, by which the peſtle is to be managed in grinding, which is to be continued for three weeks, at the end of which the gold will be reſolved into a potable liquor: This method, as it is much more ſimple, ſo the author eſteems it much more expedient than the former, on account of the ſulphureous ſaline quality of iron, which, being opened, and highly ſubtilized by grinding, acts the more powerfully on the ſolid body of gold, and attracts the ſalts in the air in greater plenty than can be done in a glaſs or golden mortar; and if it be objected, that by the continual grinding the ſteely particles are worn off, and mixed with thoſe of the gold; the author would have it conſidered, how great an affinity there is between theſe ſulphurs, and alſo the great uſe of digeſtion, which ſeparates the pure from the impure, and withal excites that occult fire of *Mars*, well known to the true ſearchers of nature, which, aſſiſted by the alcohol of wine, is able to concoct the little immature portion to a due maturity.

Experiments on Vipers; *by Mr.* Tho. Platt. Phil. Tranſ. N° 87. p. 5060.

UPON wounding a pigeon with the teeth of a viper, whoſe head had been cut off the ſame morning, by thruſting twice the maſter-teeth into the fleſhy part of the pigeon's breaſt, and preſſing the upper part of the jaw, the two little bladders, that ſerve as gums to the teeth, diſcharged into the wound ſome of that yellow liquor, which is here ſuppoſed to be the true and only poiſon of the viper; the pigeon began immediately to ſtagger, and it died in leſs than three or four minutes: Another pigeon was wounded in the ſame manner, and it languiſhed for half a quarter of an hour: Upon wounding with ſharp pricks of broom, beſmeared with the viper's yellow juice, the breaſts of two pigeons, they died in four or five minutes; tho' another pigeon, that had been wounded with a larger prick, without any of the yellow liquor, did well and lived: It having been ſaid, that to ſwallow a viper's head was a certain antidote againſt the bite; a cock was made to ſwallow one, and then he was bitten in both thighs by a live viper; the other experiment was made, by thruſting the teeth of a dead viper's head into another pigeon, after firſt ſwallowing one of theſe heads; the event was, that both died, the cock within a quarter of an hour, and the pigeon in leſs than four minutes: A pigeon wounded by a viper's head, that had been dead ſo long, that the liquor in the gums was quite dried up, ſo that none of it could be expreſſed, did very well and lived: A young bitch was bit twice by a live viper in the middle of the pendulous part of the ear; upon which ſhe ſoon began to give ſigns of death by ſtaggering, vomiting, and convulſions; after which, recovering herſelf a little, the ſame ſymptoms recurred, and in four hours after being bit, ſhe was motionleſs, and ſeemed quite dead, lolling out her tongue, and looking very ghaſtly, without any other ſigns of life, beſides that of a painful breathing, with a faint barking and languiſhing howling; ſhe was found next morning in the ſame condition, only her reſpiration was weaker, and ſhe appeared juſt expiring; it was obſerved that no part of her body was ſwelled, nor was there any ſpot ſeen upon it; ſhe had voided ſome matter of a very black colour, and a ſwarm of gnats and waſps faſtening upon her, a ſervant knocked her on the head: After this, two capons and a pullet were bit by a freſh viper, irritated on purpoſe, and becauſe they gave not

not then any ſigns of being ill, they were ſent back to their coops, and continued well till evening; but next morning, one of the capons and the pullet were found dead.

Mr. Newton's *Anſwer to ſome Conſiderations on his* Theory *of* Light *and* Colours. Phil. Tranſ. N° 88. p. 5084.

THE animadverter, in the firſt place, reprehends Mr. *Newton*, for laying aſide the thoughts of improving optics by refractions; but what Mr. *Newton* ſaid, was in reſpect of teleſcopes of the ordinary conſtruction, that their improvement is not to be expected from the well figuring of glaſſes, as opticians have imagined; tho' he deſpaired not of their improvement by other conſtructions, which made him cautious to inſert any thing that might intimate the contrary; for tho' ſucceſſive refractions, that are all made the ſame way, do neceſſarily more and more augment the errors of the firſt refraction, yet it ſeemed not impoſſible for contrary refractions ſo to correct each others inequalities, as to make their difference regular, and if that could be conveniently effected, there would be no further difficulty; and for this end, he examined what might be done not only by glaſſes, but more eſpecially by a complication of divers ſucceſſive mediums, as by two or more glaſſes or chryſtals with water, or ſome other fluid between them, all which together may perform the office of one glaſs, eſpecially of the object-glaſs, on whoſe conſtruction the perfection of the inſtrument chiefly depends: He denies, that rays are reflected leſs true to a point by a concave, than refracted by a convex, or that the focus of the latter is a line leſs than that of the former, the contrary appearing from the following table, which is computed for ſuch a reflecting concave and refracting convex; on the ſuppoſition that they have equal apertures, and collect rays at an equal diſtance from their vertex; which diſtance being divided into 15000 parts, the diameter of the concave ſphere will be 60000 of thoſe parts, and of the convex 10000; ſuppoſing the ſines of incidence and refraction to be in round numbers, as 2 to 3; and the following table ſhews how much the exterior rays, at ſeveral apertures, fall ſhort of their principal focus.

The diameter of the aperture.	The parts of the axis intercepted between the vertex and the rays.		The errors by	
	reflected.	refracted.	reflect.	refract.
2000	14991⅔	14865	8⅓	135
4000	14966	14449	33	551
6000	14924	13699	76	1301
8000	14865	12475	135	2525
10000	14787	9472	213	5528

By this may be ſeen, that the errors of the refracting convex are ſo far from being leſs, that they are more than ſixteen times greater than the like errors of the reflecting concave, eſpecially in large apertures, and that without regarding the heterogeneous conſtitution of light; ſo that however the contrary ſuppoſition might make the author of theſe animadverſions reject reflexions as uſeleſs for the promoting of optics, yet for this as well as other conſiderations, they are preferable in the theory to refractions: Whether the parabola be more difficult to deſcribe than the hyperbola or ellipſis, may be a queſtion; but there is no abſolute neceſſity of endeavouring after deſcriptions of any of them, for if metals can be ground truly ſpherical, they will bear as great apertures, as men can well communicate an exact poliſh to; and for dioptric teleſcopes, the difficulty does not conſiſt in the figure of the glaſs, but in the difformity of refractions.

The conſiderations on Mr. *Newton*'s theory conſiſt in aſcribing an hypotheſis to him, which is none of his; in aſſerting an hypotheſis, which, as to the principal parts, is not againſt him; in granting the greateſt part of his diſcourſe, if explained by that hypotheſis; and in denying ſome things, whoſe truth would appear by an experimental examination.

Theſe particulars Mr. *Newton* treats in order, and firſt of the hypotheſis, which is aſcribed to him in theſe words; *but grant this firſt ſuppoſition, that light is a body, and that as many colours or degrees as there are poſſible, ſo many bodies there may be, all which compounded together would make white*, &c. It is true that from his theory he concludes, that light is a body, making it at moſt a probable conſequence only of his doctrine, and not a fundamental ſuppoſition, nor ſo much as any part of it, which was entirely comprehended in the

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preceeding propofitions; had he intended any fuch hypothefis, he fays, he fhould have fomewhere explained it; but he was aware that the properties of light were in fome meafure capable of being accounted for, not only by that, but by many other mechanical hypothefes, and therefore he chofe to decline them all, and fpeak of light in general terms, confidering it abftractedly, as fomething or other propagated every way in right lines from luminous bodies, without determining what it was, whether a confufed mixture of difform qualities, or modes of bodies, or of bodies themfelves, or of any virtues, powers or beings whatfoever; and for the fame reafon he chofe to fpeak of colours according to the information of our fenfes, as if they were qualities of light without us; whereas, by that hypothefis, he muft have rather confidered them as modes of fenfation, excited in the mind by various motions, figures, or fizes of the corpufcles of light, making various mechanical impreffions on the organ of fenfe: But fuppofing Mr. *Newton* had propounded that hypothefis, the objecter feems to have no reafon to be fo much againft it, fince it has a greater affinity with his own than he feems to be aware of; the vibrations of the *Æther* being as ufeful and neceffary in this, as in his own hypothefis; fuppofing the rays of light to be fmall particles emitted every way from fhining fubftances, thefe, when they impinge on any refracting or reflecting furfaces, muft as neceffarily excite vibrations in the *Æther*, as ftones do in water when thrown into it; and fuppofing thefe vibrations to be of feveral depths or thickneffes, according as they are excited by the various fizes and velocities of thefe corpufcular rays, he leaves it to the confideration of thofe who may apply this hypothefis to the folution of phænomena, of what ufe they may be in explaining the manner of reflection and refraction, the production of heat by the fun-beams, the emiffion of light from burning, putrified, or other fubftances, whofe parts are vehemently agitated; the phænomena of thin tranfparent plates and bubbles, and of all natural bodies, the manner of vifion, and the differenee of colours, as alfo their harmony and difcord.

In the fecond place, the objecter's hypothefis, as to the fundamental part of it, is not againft Mr. *Newton*, and which is this; *that the parts of bodies, when briskly agitated, do excite vibrations in the* Æther, *which are propagated every way from thofe bodies in right lines, and caufe a fenfation of light by beating and dafhing againft the bottom of the eye, in much the fame*

ſame manner, as vibrations in the air cauſe a ſenſation of ſound by beating againſt the organs of hearing. Now the moſt free and natural application of this hypotheſis to the ſolution of phænomena, is this; the agitated parts of bodies, according to their ſeveral bulks, figures and motions, do excite vibrations in the *Æther* of various depths or bigneſſes, which being promiſcuouſly propagated thro' that medium to our eyes, cauſe in us a ſenſation of light of a white colour; but if by any means thoſe of unequal bigneſſes be ſeparated from each other, the largeſt beget a ſenſation of a red colour, the leaſt or ſhorteſt, of a deep violet, and the intermediate ones, of intermediate colours, much after the manner that bodies, according to their ſeveral bulks, ſhapes, and motions, excite vibrations in the air of various bigneſſes, which, according to theſe bigneſſes, make ſeveral tones in ſound; that the largeſt vibrations are beſt able to overcome the reſiſtance of a refracting ſurface, and ſo break thro' it with leaſt refraction, whence the vibrations of ſeveral bigneſſes, that is, the rays of ſeveral colours, which are blended together in light, muſt be ſeparated from each other by refraction, and ſo cauſe the phænomena of priſms and other refracting ſubſtances; and that it depends on the thickneſs of a thin tranſparent plate or bubble, whether a vibration ſhall be reflected at its farther ſurface, or tranſmitted; ſo that according to the number of vibrations, between the two ſurfaces, they may be reflected or tranſmitted for many ſucceſſive thickneſſes; and ſince the vibrations which produce blue and violet are ſuppoſed ſhorter than thoſe that make red and yellow, they muſt be reflected at a leſs thickneſs of the plate; which is ſufficient to explain all the ordinary phænomena of thoſe plates or bubbles, and alſo of all natural bodies, whoſe parts are like ſo many fragments of ſuch plates: And theſe conditions of this hypotheſes ſeem juſtly to agree with Mr. *Newton*'s theory; tho' the fundamental ſuppoſition itſelf ſeem impoſſible, *viz.* that the waves or vibrations of any fluid, can, like the rays of light, be propagated in ſtraight lines, without a continual and very great ſpreading and bending every way into the quieſcent medium, where they are terminated: What has been ſaid of this may be eaſily applied to all other mechanical hypotheſes, in which light is ſuppoſed to be cauſed by any preſſion or motion whatſoever, excited in the *Æther* by the agitated parts of luminous bodies; for it ſeems impoſſible, that any of theſe motions or preſſions can be propagated in right lines without a ſimilar ſpreading every way into

into the ſhadowed medium, on which they terminate; but yet if it ſhould be thought poſſible, it muſt be allowed that thoſe motions or endeavours to motion cauſed in the *Æther* by the ſeveral parts of any lucid body that differ in bulk, figure and agitation, muſt neceſſarily be unequal; which is ſufficient to denominate light an aggregate of difform rays, according to any of theſe hypotheſes.

The third thing to be conſidered is the animadverter's conceſſions, for he grants, that without regarding a different incidence of rays there are different refractions, which he would explain by the ſplitting and rarifying of *Ætherial* pulſes, and not by the different refrangibility of the ſeveral rays; he grants that uncompounded colours are unchangeable, and that compounded ones are changeable, only by reſolving them into the colours of which they conſiſt; and that all the changes which can be wrought in colours, are effected only by variouſly mixing or ſeparating them; but he makes theſe conceſſions, providing colours be explained by the two ſides of a ſplit pulſe, and makes only two ſpecies of them, accounting all the other colours to be only various degrees and dilutings of theſe two; and he further grants, that whiteneſs is the reſult of the uniting of all the colours, providing it be allowed to be not only by mixture of theſe colours, but alſo by a farther uniting of the parts of the ray ſuppoſed to be formerly ſplit: And if theſe explications were examined, it would be eaſy to ſhew, that they are not only inſufficient, but in ſome reſpects unintelligible; for, tho' it be eaſy to conceive how motion may be dilated and ſpread, or how parallel motions may become diverging, yet there is no conceiving, by what artifice any linear motion can by a refracting ſurface be infinitely dilated and rarified, ſo as to become ſuperficial; or, if that be ſuppoſed, why it ſhould be ſplit at ſo ſmall an angle only, and not rather ſpread and diſperſed thro' the whole angle of refraction; and further, tho' it may be eaſily imagined, how unlike motions may croſs each other, yet it is not eaſy to conceive, how they ſhould coaleſce into one uniform motion; and then ſeparate again, and recover their former unlikeneſs; and it is as unintelligible how the direct uniform and undiſturbed pulſes ſhould be ſplit and diſturbed by refraction, and yet the oblique and diſturbed pulſes perſiſt without ſplitting or further diſturbance by ſucceeding refractions. But Mr. *Newton* does not think it neceſſary to explain his doctrine by any hypotheſis; for if light be conſidered abſtractedly, it is as eaſily conceivable, that

that the ſeveral parts of a ſhining body may emit rays of differing colours and other qualities, of which light is conſtituted; as that the ſeveral parts of a falſe or uneven ſtring, or of water unevenly agitated in a brook or cataract, or the ſeveral pipes of an organ inſpired all at once, or all the variety of ſounding bodies ſhould produce ſounds of ſeveral tones, and propagate them thro' the air, intermix'd in a confuſed manner; and if there were any natural bodies that could reflect ſounds of one tone, and ſtifle or tranſmit thoſe of another, then, as the echo of a confuſed aggregate of all tones would be that particular tone, which the echoing body is diſpoſed to reflect; ſo ſince by the animadverter's conceſſions there are bodies apt to reflect rays of one colour, and ſtifle or tranſmit thoſe of another, it is as eaſily conceived, that theſe bodies when illuminated by a mixture of all colours, muſt appear of that colour only which they reflect.

In the laſt place Mr. *Newton* reduces the difficulties in the animadverter's diſcourſe to three queries. 1. Whether the unequal refractions made without regarding any inequality of incidence be cauſed by the different refrangibility of the ſeveral rays, or by the ſplitting, breaking or diſſipating the ſame ray into diverging parts? 2. Whether there be more than two ſorts of colours? 3. Whether whiteneſs be a mixture of all colours? The firſt of theſe queries was determined by experiment, the deſign of which was to ſhew, that the length of the coloured image did not proceed from any unevenneſs in the glaſs, or any other contingent irregularity in the refractions; for the light was refracted ſucceſſively with two priſms contrary ways; that the ſecond priſm might deſtroy the regular effects of the firſt, and diſcover the irregular effects by augmenting them with reiterated refractions; now if the firſt priſm had diſſipated every ray into an indefinite number of diverging parts, the ſecond ſhould in like manner have diſſipated every one of theſe parts into a further indefinite number, whereby the image would have been ſtill more dilated, contrary to the event; the ſecond priſm was ſometimes in a tranſverſe poſition to the firſt, to try, if it would make the long image become four-ſquare; on trial it proved otherwiſe, for the image was as regularly oblong as before, and inclined to both the priſms at an angle of 45°, its breadth anſwering to the ſun's diameter, and its length greater or leſs, according as the refractions agreed more or leſs, or were contrary to each other; and ſince the breadth of the image was not augmented by the

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croſs refraction of the ſecond priſm, that refraction muſt have been performed without any ſplitting or dilatation of the ray; and therefore the light incident on that priſm muſt be granted to be an aggregate of rays unequally refrangible in Mr. *Newton*'s ſenſe; and ſince the image was equally inclined to both priſms, and conſequently the refractions alike in both, it ſhews they were performed according to ſome conſtant law, without any irregularity.

In order to determine the ſecond query, the animadverter refers to an experiment made with two wedge-like boxes, mentioned in Dr. *Hook*'s micrography, obſervation 10. p. 73, the deſign of which was to produce all colours out of a mixture of two; but there is a double defect in this inſtance, for it does not appear, that by this experiment all colours can be produced out of two, and if they could, yet the inference would not follow: That all colours cannot by that experiment be produced out of two, will appear by conſidering that the tincture of aloes, which afforded one of thoſe colours, was not all over of one uniform colour, but appeared yellow near the edge of the box, and red at other places where it was thicker, affording all variety of colours from a pale yellow to a deep red or ſcarlet, according to the various thickneſs of the liquor; and thus the ſolution of copper, which afforded the other colour, was of various blues and indigo's, ſo that inſtead of two colours, here is a great variety applied for the production of all the other colours; and to ſay that all the reds and yellows of the one liquor, or blues and indigo's of the other, are only various degrees and dilutings of the ſame colour, and not different colours, is begging the queſtion; but that they are different colours will more fully appear from this reaſon, that the tincture of aloes is qualified to tranſmit moſt eaſily the rays indued with red, and moſt difficultly the rays endued with violet, and with intermediate degrees of facility the rays indued with intermediate colours; ſo that where the liquor is very thin, it may ſuffice to intercept moſt of the violet, and yet tranſmit moſt of the other colours, all which together muſt compoſe a middle colour, that is, a faint yellow; and where it is ſo much thicker, as to intercept moſt of the blue and green; the remaining green, yellow and red muſt produce an orange; and where the thickneſs is ſo great, that ſcarce any rays can paſs thro' it, beſides thoſe endued with red, it muſt appear of that colour; and that ſo much the deeper and obſcurer, by how much the liquor is thicker; and the ſame may

be underſtood of the various degrees of blue, exhibited by the ſolution of copper; by reaſon of its diſpoſition to intercept red moſt eaſily, and tranſmit a deep blue or indico colour moſt freely: But ſuppoſing all colours might, according to this experiment, be produced out of two by mixture, yet it does not follow, that thoſe two are the only original colours, and that for two reaſons; firſt, becauſe theſe two are not themſelves original colours, but compounded of others, there being no liquor, nor any other body in nature, whoſe colour in day-light is entirely uncompounded: And in the next place, becauſe tho' theſe two were original, and all others might be compounded of them, yet it follows not that they might not be otherwiſe produced; for colours have a twofold original, the ſame colours being to ſenſe in ſome caſes compounded, and in others uncompounded; and ſince all white objects thro' the priſm appear confuſed and terminated with colours, whiteneſs, muſt according to this diſtinction, be ever compounded, and that the moſt of all colours, becauſe it is the moſt confuſed and moſt changed by refractions; and this may afford a hint for improving microſcopes by refraction, which is by illuminating the object in a darkened room with light of any convenient colour, not too much compounded, for by that means the microſcope will bear a deeper charge and larger aperture; eſpecially if its conſtruction be ſuch as may hereafter be deſcribed, for the advantage in ordinary microſcopes will not be ſo ſenſible.

The third query is, whether whiteneſs be an uniform colour, or a diſſimilar mixture of all colours; and that it is the latter is plain from the experiment, for if any colour be intercepted at the lens, the whiteneſs will be changed into the other colours; and if all the colours but red be intercepted, that red alone in the concourſe or croſſing of the rays will not conſtitute whiteneſs, but continue as much red as before, and ſo of the other colours; and there are other circumſtances by which the truth might have been decided, as by viewing the white concourſe of the colours thro' another priſm placed cloſe to the eye, by whoſe refraction that whiteneſs may appear again transformed into colours; and then, to examine their origin, if an aſſiſtant intercept any of the colours at the lens before their arrival at the whiteneſs, the ſame colours will vaniſh from amongſt thoſe, into which that whiteneſs is converted by the ſecond priſm; now if the rays which diſappear be the ſame with thoſe that are intercepted, then it muſt be acknowledged that

that the ſecond priſm makes no new colours in any rays, which were not in them before their concourſe at the paper; which is a plain indication, that the rays of ſeveral colours remain diſtinct from each other in the whiteneſs, and that from their previous diſpoſitions are derived the colours of the ſecond priſm; and what is ſaid of their colours may be applied to their refrangibility.

Obſervations about ſhining Fleſh; *by Mr.* Boyle. Phil. Tranſ. N° 89. p. 5108.

THE honourable Mr. *Boyle* obſerved a joint of meat, which was a neck of veal, to ſhine in ſeveral places, to the number of 20, tho' not all alike, as rotten wood or ſtinking fiſh do; the bigneſs of theſe lucid parts was ſufficiently different, nor were their figures uniform; ſome being round, others almoſt oval, but generally very irregularly ſhaped; the parts that ſhone moſt, were ſome griſtly or ſoft parts of the bones, where the butcher's cleaver had paſſed, tho' not the only parts that were luminous; for by moving to and fro the ſpinal marrow, a part of it emitted light; and he perceived one place in a tendon to afford ſome light; and laſtly three or four ſpots in the fleſhy parts, at a good diſtance from the bones, were plainly diſcovered by their own light, tho' fainter than in the above-mentioned parts: When all theſe lucid parts were ſurveyed at once, they made a very ſplendid ſhow; ſo that apylying a printed paper to ſome of the more luminous ſpots, he could plainly read divers letters of the title: The colour of the light was not the ſame in each, but in thoſe that ſhone livelieſt, it ſeemed to have ſuch a fine greeniſh blue as is obſerved in the tails of glow-worms: But notwithſtanding the vividneſs of this light, it did not yield the leaſt degree of heat to the touch; and applying to the moſt ſhining places a ſealed weather-glaſs, the tinged ſpirit of wine was not obſerved to be ſenſibly affected; and notwithſtanding the great number of lucid parts, the leaſt degree of ſtench was not perceivable to infer any putrefaction, the meat being judged very freſh and well conditioned, and fit to be dreſſed: The floor of the larder where this meat was kept, was almoſt a ſtory lower than the level of the ſtreet, and divided from the kitchin by a partition of boards only, and with one ſmall window looking northward: The wind, as far as could be obſerved, was then ſouth-weſt, and pretty high; the air by the thermometer appeared hot for the ſeaſon, which was *March*, the moon was

paſt its laſt quarter; the mercury in the barometer ſtood at $29\frac{3}{16}$ inches: One of the luminous parts, which proved to be a tender bone, and of the thickneſs of a half-crown piece, appeared to ſhine on both ſides, tho' not equally; and the part of the bone, whence this had been cut off was ſeen to ſhine, but nothing near ſo vividly as the part taken off did before; it yielded no luminous juice, or moiſt ſubſtance, as the tails of glow-worms do; upon compreſſing a piece of luminous fleſh between two pieces of glaſs, its light was not extinguiſhed; putting a luminous piece of veal into a chryſtalline phial, and pouring on it a little pure ſpirit of wine and ſhaking them together, in about a quarter of an hour, or leſs, the light was vaniſhed; but water could not ſo eaſily quench this fire, for putting one of the pieces into a china-cup, almoſt full of cold water, the light did not only appear thro' that liquor, but above an hour after was vigorous enough not to be eclipſed by being looked upon at no great diſtance from a burning candle; upon conveying one of the largeſt luminous pieces into a ſmall receiver, the pump was plied in the dark, and upon the gradual removal of the air, there was perceived a gradual diminution of the light, tho' never quite diſappear'd, as the light of rotten wood and glow-worms were obſerved to do; but by the haſty encreaſe of light, that diſcloſed itſelf in the veal upon admitting the air into the exhauſted receiver, it appeared that the decrement, tho' but ſlowly made, had been conſiderable; this experiment was once more repeated with the like ſucceſs, which tho' it was a proof that this luminous matter was more vigorous or tenacious than that of moſt other ſhining bodies, yet there remained ſome doubt, whether the light would not have been much more impaired, if not made to vaniſh quite, if the ſubject of it could have been kept long enough in the exhauſted receiver: It was alſo found, that a leg of the ſame veal had ſome ſhining places in it, tho' but very few and faint, in compariſon of thoſe that were conſpicuous in the above-mentioned neck: A luminous piece of veal included in a phial, after three days ſhone as vigorouſly as ever; the fourth day its light was alſo conſpicuous, ſo that it could be ſeen even in the day time in a dark corner of the room; but before the enſuing night the light began to decay, and the offenſive ſmell to grow ſomewhat ſtrong; which ſeems to argue, that the diſpoſition, by which the veal became luminous, may very well conſiſt both with its being and not being in a ſtate of putrefaction; and conſequently is not likely to be derived from the one

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or the other; the fifth day, in the morning, looking upon it before the curtains were opened, it ſeemed to be more luminous than the preceeding day; the ſame night it was manifeſt enough in the dark, tho' not vivid; the ſixth day in the morning after ſun-riſing, there was within the curtains a glimmering light obſervable; but the ſeventh day late at night no light at all was diſcernable: Some time after a pullet was obſerved to ſhine in four or five places in the ſame larder, tho' not ſo large as thoſe of the veal, yet almoſt as vivid; and all theſe luminous parts were upon or near the rump, and that which appeared moſt like a ſpark of fire, ſhone at the very top of that part, yet the fowl was freſh and ſound.

An odd Kind of Muſhroom; *by Dr.* Liſter. Phil. Tranſ. N° 89. p. 5116.

AS Dr. *Liſter* paſſed thro' *Marton-woods*, under *Pinno-moor* in *Craven*, he found an infinite number of muſhrooms, ſome withered, and others new ſprung up and flouriſhing; they were of a large ſize, ſomething bigger than the ordinary red gilled eatable muſhroom, or champignon, and very much of their ſhape, that is, with a perfectly round cup, or ſtool, as it is popularly called; thick in fleſh, and with open gills underneath, and with a thick fleſhy, round, ſolid foot-ſtalk, about ſix fingers high above ground, and ordinarily as thick as one's thumb: If you cut any of this muſhroom, it will bleed very freely a milky juice, which taſtes much hotter on the tongue than pepper, not clammy to the touch, not much diſcoloured by the air, or the blade of a knife, as is uſual with moſt vegetable juices; it became ſuddenly concreted in the glaſs phial into which it was drawn, and in ſome days was dried into a firm cake, which alſo retained its fierce biting taſte and white colour; and notwithſtanding the heat of this juice, it was obſerved to abound with fly-maggots; and the youngeſt and tendereſt of theſe muſhrooms, that is the moſt juicy, were much eaten by the grey meadow naked ſnail, lodging themſelves within the ſides of the plant. Mr. *Wray* is of opinion, that this muſhroom is the ſame with that deſcribed in *Joh. Bauhin*, *l.* 40. *c.* 6. under the title of *Fungus piperatus albus, lacteo ſucco turgens*, for almoſt in all points the deſcriptions agree exactly.

Of

Of Veins *in* Plants; *by Dr.* Lifter. Phil. Tranf. N° 90. p. 5132.

THE fkin of a plant may be entirely cut off with part of the fpongy *Parenchyma*, and no figns of milky juice follow, that is, no breach of a vein; again, the plant has been ftripped of its fkin by pulling it up by the roots, and expofing it to the wet weather, untill it became flaccid, without any injury to the veins, which yet, upon incifion, would bleed: Thefe experiments make againft the general opinion of one only fap, loofely pervading the whole plant, like water in a fponge: In the tranfverfe cuts of plants, are feen, as it were, a certain order and number of the bloody orifices of diffected veins; we obferve alfo in a leaf, which is taken to be the fimpleft part of a plant. 1. That the veins accompany the ribs and nerves, as they are commonly called, and are diftributed into all the parts of the leaf, according to the fubdivifions of thofe nervous filaments, and are with them difpofed into a certain net-work, whether by inofculations, or bare contact only, he pretends not to determine. 2. That in a tranfverfe cut of a leaf, the middle fibre or nerve, for inftance, feems to yield one big drop of a milky juice, fpringing, as it were, from one vein, yet by the microfcope it plainly appears, that there are many veins, which contribute to the making up that drop. 3. That if a fibre or nerve be carefully taken out of the leaf, the veins will appear in it, like fo many fmall hairs, or pipes running along the nerve. 4. That thofe numerous veins are all of an equal bignefs, for ought has been yet obferved to the contrary. 5. Tho' we feem to be more certain of the ramifications of the fibres, wherein thefe veins are, yet we are not fo, that thefe veins do any where grow fmaller, tho' probably they may do fo; what caufes the doubt is the exceeding fmallnefs of thefe veins, even where we might probably expect them to be trunk-veins. 6. That we cannot difcern any where, throughout the whole plant, larger, or more capacious veins, than thofe we fee adhering to the fibres of the leaves, which alfo appears from comparing the bleeding orifices in a tranfverfe cut.

Dr. *Lifter* is of opinion, that thefe veins do ftill accompany their refpective fibres; that all the fibres of the leaf are joined in the ftalk, and that ftalk explicated in clothing the twig or ftem of the plant feems to be the reafon of the regular budding of the leaves; that thofe of the twigs unite in the branches, and

and thofe of the branches in the trunk, or body of the tree; the like feems to be obferved in an inverted order in the feveral coats and ramifications of the root, and this the feveral circles of bleeding orifices in tranfverfe cuts feem to confirm: But in the roots of plants, if a fimple coat be feparated, and expofed between your eye and the light, the veins appear to be ftrangely entangled, and not in the fame fimple order as in the leaves; the like feems to hold of the bark of the bodies of trees: From what has been faid, it may well be doubted, whether there is any *Sinus*, or common trunk, into which all the veins do unite; but rather, that there are a multitude of veins equally large, each exifting a-part by itfelf: The fubftance of thefe veins feems to be as truly membranous, as thofe of animals, and like them are elaftic; again, thefe membranous pipes are exceeding thin and tranfparent, for they fuddenly difappear and fubfide, after they are exhaufted of their juice, and in particular, the liquor, they contain, is feen quite thro' them: In the keeneft froft the juice was frozen into perfect hard ice, but the milky juice in the veins was as liquid as ever, but not fo brifk, as in open weather; whence it appears that this latter is endued with a certain degree of fermentation, by which both itfelf and the plant are preferved from the injuries of the weather; and hence alfo appear the different ufes and natures of thefe juices, and that the frozen ificles, or that copious, diluted and limpid fap is alimental, and the milky unfrozen juice, the only proper venal juice.

As to the motion of thefe juices, it is certain; 1. That the milky juice always moves and fprings brifkly upon the opening of a vein; the limpid fap only at certain feafons. 2. That the venal juice has a manifeft inteftine motion, or fermentation.

According to the knowledge we yet have of the parts of plants, thefe juices feem to move by a mechanifm of parts far different from that of animals; for in plants we do not yet difcover any uniting of veins into one common trunk, no pulfation, no fenfible fwelling by ligature, nor difference in veins, *&c.*

There feem to be manifeft figns of fenfation in plants, as appears from the fudden fhrinking of fome, the frequent clofing and opening of flowers, the raifing the heads of poppies from a pendulous to an erect pofition, and particularly, the vermicular motion of the veins, when expofed to the air.

As the preventing the blood of animals from coagulating, is one reafon for the neceffity of a circulation in them, fo the

fame

ſame thing holds for a like circulation in plants; for their juices do immediately break and coagulate, and the ſerum in one as well as in the other becomes a ſtiff jelly by a little ſtanding; and it appears by various experiments, that probably more uſeful preparations, and a truer analyſis, and ſeparation of the parts of vegetable drugs might be effected, whilſt they are bleeding and liquid, than after they once become concreted, and have loſt their natural fermentation.

A Freezing Rain *in* Somerſetſhire; *by Dr.* Beale. Phil. Tranſ N° 90. p. 5138.

THE freezing rain, which fell here in *December* 1672, has made ſuch a deſtruction of trees from *Briſtol* to *Wells*, *Shepton-mallet*, *Bath* and *Bruton*, and other places of the weſt as may ſeem incredible: It deſtroyed many orchards expoſed to the north-eaſt; had it concluded with ſome guſts of wind, it might have been of bad conſequence; the ice, on a ſprig of an aſh-tree of juſt $\frac{3}{4}$ of a pound, weighed 16 pounds; and a ſmall bent or bulruſh was encompaſſed with ice five inches in circumference; and yet tho' the trees and hedges were loaden with ice, there was none to be ſeen on rivers, nor on ſtanding pools: Some travellers were almoſt killed by the coldneſs of the freezing air and rain; all the trees on the highway from *Briſtol* to *Shepton*, were ſo torn and broken down by the weight of the ice, that the road was become unpaſſable; ſome were affrighted with the noiſe in the air, till they obſerved it was owing to the ſhock of the icy boughs againſt each other; ſome again ſaw this freezing rain fall upon the ſnow, and immediately freeze to ice, without ſinking into it, ſo that it was all along covered with ice: Theſe froſts were immediately ſucceeded by glowing heats, which cauſed exceſſive ſweatingboth by night and day; the buſhes and flowers appeared in ſuch forwardneſs, as if it had been in *April* or *May*; an apple-tree bloſſom'd before *Chriſtmaſs*, and bore apples perfectly knit before new-year's tide, and as big as the end of one's finger.

A method of drawing Tangents *to all geometrical* Curves; *by M.* Sluſius. Phil. Tranſ. N° 90. p. 5143. *Tranſlated from the* Latin.

LET any curve DQ (Fig. 6. Plate XI.) be given, all whoſe points may be referred to any given right line EAB, thro' the right line AD; it matters not, whether EAB be

be a diameter or any other line, or whether there be alſo given other lines, which, or their powers, may come into the equation.

In an analytical equation, for greater plainneſs, let D A be always deſigned by v, B A by y, and let E B and other known quantities be expreſſed by conſonants; then let D C be ſuppoſed drawn, touching the curve in D, and meeting E B produced, if needful, in the point C; and let C A be always called a; and this will be the general rule for finding C A or a. 1. Reject out of the equation all thoſe members, in which either y or v is not found; then put all thoſe that have y, on one ſide; and all thoſe which have v, on the other, with their ſigns $+$ or $-$; and let the latter for diſtinction and eaſe ſake be called the right, the former, the left ſide. 2. On the right ſide let there be prefixed to each member, the exponent of the power, which v has there, or which is all one, multiply all the members into that exponent. 3. Let the ſame be done alſo on the left ſide, multiplying each member there by the exponent of the power of y therein; and beſides, let one y in each member be always changed into a: The equation thus reformed ſhews the method of drawing a tangent to the given point D; for ſince that point is given, y and v are likewiſe given, as alſo the other quantities expreſſed by conſonants, conſequently a muſt be known: Any obſcurity that may be in this rule, will be cleared up by ſome examples; let this equation $by - y^2 = v^2$ be given, in which let E B be b; B A y; D A, v, and let a or A C be ſought, ſo that drawing D C, it may touch the curve DQ in D: According to the rule, nothing is to be rejected out of this equation, ſince in each of its members either y or v may be found; and it is beſides ſo diſpoſed, that on one ſide are all the members in which y is, and on the other ſide all thoſe in which v is found; there is therefore only to be prefixed to each member the exponent of the power of y or v in each, and on the left ſide one y to be changed into a, that it may be $ba - 2ya = 2vv$; now this equation ſhews the method of drawing a tangent to the point D, or $a = \frac{2vv}{b - 2y} =$ A C: And if the equation $qq + by - yy = vv$ were given, the equation for the tangent would be entirely the ſame with the preceeding, after rejecting qq according to the rule; ſo from $2by^2 - y^3 = v^3$ ariſes $4bya - 3yya = 3v^3$, or $a = \frac{3v^3}{4by - 3yy}$; from $bby + zyy + y^3 = qvv$, is made $bba + 2zya + 3yya = 2qvv$, and $a =$

$a = \frac{2qvv}{bb + 2zy + 3yy}$; and $b^4 + by^3 - y^4 = qqvv + zv^3$ becomes $3byya + 4y^3a = 2qqvv + 3zv^3$, and $a = \frac{2qqvv + 3zv^3}{3byy - 4y^3}$; in these and such like equations there can be no difficulty; possibly there may be a little in those, some of whose members consist of the products of y into v; as yv, yyv, y^3vv, &c. yet that difficulty is but inconsiderable, for suppose you have $y^3 = bvv - yvv$, nothing is to be thrown out of this equation, since either y or v is found in each member; but that it may be disposed according to the rule, yvv must be taken twice, and be put both on the right side, in which are members having v, and on the left side, whose members have y, since yvv contains both y and v; then you must make $y^3 + vvy = bvv - yvv$, and changing this equation into another, *viz.* $3yya + vva = 2bvv - 2yvv$, a will be equal to $\frac{2bvv - 2yvv}{3yy + vv}$; for the rule is to be thus understood, *viz.* that on the left side the power of v is not to be regarded, wherefore the exponent of vv must not be prefixed to yvv, only that of y; as on the right side, the power of y in yvv must not be regarded, but only that of v, whose exponent is to be prefixed; thus, if it were $y^5 + by^4 = 2qqv^3 - yyv^3$, it should be $y^5 + by^4 + yyv^3 = 2qqv^3 - yyv^3$, and the equation for the tangent would be $5y^4a + 4by^3a + 2yav^3 = 6qqv^3 - 3yyv^3$, and $a = \frac{6qqv^3 - 3yyv^3}{5y^4 + 4by^3 + 2yv^3}$. And these examples seem to comprehend all possible variety of cases; but perhaps it may be of use to apply what was explained in general to some particular line or other: Let therefore the curve BD, Plate XI. Fig. 7. be given, of such a property, that assuming in it any point D, and BD be drawn, and DE erected perpendicular thereto, meeting the right line BE in E, the right line DE may be always equal to the right line BF; to express the equation analytically, let DA be v; BA, y; BF or DE, q; then will EA be equal to $\frac{vv}{y}$, and the square of DE being equal to the two squares of DA and AE, the equation will be $qq = \frac{v^4}{yy} + vv$, or $qqyy = v^4 + yyvv$, which, according to the rule, is to be thus reformed for the tangent, $qqyy - yyvv = v^4 + yyvv$, and

$2qqya$

$2qqya - 2vvya = 4v^4 + 2yyvv$, and $a = \frac{4v^4 + 2yyvv}{2qqy - 2vvy}$: A ſkilful mathematician cannot be ignorant how to reduce ſuch equations to eaſier expreſſions for conſtruction; as in this example, ſeeing the rectangle B A E is ſuppoſed equal to the ſquare of A D, if E A be called e, it will be $vv = ye$, and $v^4 = yyee$, and $qq = ye + ee$; therefore ſubſtituting their value in the equation, it is $a = \frac{2ey + yy}{e}$, that is, $ae = 2ey + yy$, and adding ee to both ſides, $ae + ee = ee + 2ey + yy$; therefore the three quantities e, $e + y$, and $e + a$, or E A, E B, and E C will be in continued proportion, and the conſtruction will become eaſy.

As it has been hitherto ſuppoſed, that the tangent be drawn towards B, tho' it may happen from the *data* to be either parallel to A B, or to be drawn to the contrary part, ſo it now remains to determine, how this variety of caſes may be diſtinguiſhed in equations; making a fraction for a as in the above-mentioned examples, the parts both of the numerator and denominator with their ſigns are to be conſidered; for 1. If in both parts of the fraction all the ſigns be either affirmative, or at leaſt the affirmative exceed the negative, the tangent is to be drawn towards B. 2. If the affirmative quantities exceed the negative in the numerator, but be equal to them in the denominator, the right line drawn thro' D parallel to A B will touch the curve in D; for in that caſe a is of an infinite length. 3. If both in the numerator and denominator, the affirmative quantities be leſs than the negative, changing all the ſigns, the tangent is again to be drawn towards B, and this caſe coincides with the firſt. 4. If the affirmative quantities exceed in the denominator, and come ſhort of the negative in the numerator, or on the contrary, then changing the ſigns in that part of the fraction where they are leſs, the tangent muſt be drawn a contrary way, that is, A C muſt be taken towards E. 5. But whenever the affirmative and negative quantities are equal in the numerator, let them be how they will in the denominator, a will become nothing; and conſequently the tangent is either A D itſelf, or E A, or parallel thereto, as will eaſily be found by the *data*; and theſe various caſes may be explained by equations for the circle; let the diameter of a ſemicircle be E B, Fig. 8. and let D be a point given, from which the perpendicular A D may fall $= v$, let B A $= y$, B E $= b$, the equation will be $by - yy = vv$, and drawing the tangent

 D C,

D C, it will be A C, or $a = \frac{2vv}{b - 2y}$; now if b be greater than $2y$, the tangent is to be drawn towards B, if leſs, towards E, if equal to it, it will be parallel to E B, as was ſaid in N° 1, 2, 4: Let there be any ſemicircle inverted, as N D D, Fig. 9, the points of whoſe periphery are to be referred to the right line B E, parallel and equal to the diameter; making N B $= d$, and all things elſe as above, $by - yy = dd + vv - 2dv$; therefore A C or $a = \frac{2vv - 2dv}{b - 2y}$; now ſince v here is ſuppoſed to be always leſs than d, if b be greater than $2y$, then the tangent muſt be drawn towards E; if equal, it will be parallel to B E; if leſs, changing all the ſigns, the tangent muſt be drawn towards B, as by N° 4, 5, and 3; but there could be no tangent drawn, or at leaſt, E B would be the tangent, if N B had been taken equal to the ſemidiameter, or $2d = b$, as by N° 5: Let there be another ſemicircle, whoſe diameter N B, Fig. 10, is perpendicular to E B, and to which its points are ſuppoſed to be referred; let N B be called b, and all things ſtanding as before; the equation will be $yy = bv - vv$, and $a = \frac{bv - 2vv}{2y}$; now if b be greater than $2v$, the tangent muſt be drawn towards B; if leſs, towards E; if equal, D A will be the tangent, as by N° 1, 4, and 5. And theſe are all the various caſes that the conſideration of equations can afford.

Effects of the varying Weight of the Atmoſphere *upon Bodies in Water; by Mr.* Boyle. Phil. Tranſ. N° 91. p. 5156.

WHEN we conſider what quantity of air appears by the pneumatic engine to be lodged in the pores not only of water, but of the blood, ſerum, urine, gall, and other juices of the human body, the very alteration of the atmoſphere in point of weight may in ſome caſe have conſiderable effects on men's health; as when the ambient air, for inſtance, grows ſuddenly much lighter than it was before, or than it was wont to be; the ſpirituous and aerial particles plentifully lodged in the maſs of blood will naturally ſwell that liquor, and ſo diſtend the greater veſſels, and thus not a little alter the celerity and manner of the blood's circulation thro' the capillary arteries and veins; and the following experiment may ſerve to confirm this notion: Cauſing to be blown at the flame of a lamp three ſmall round glaſs-bubbles, about the bigneſs of hazel-nuts, and furniſhed each of them with a ſhort and ſlender ſtem, by whoſe means they

they were ſo nicely poiſed in water, that a very ſmall change of weight would make them either emerge, if they but lightly leaned on the bottom of the veſſel, or ſink, if they floated on the top of the water; this done, when the atmoſphere was of a convenient weight, they were put into a wide-mouth'd glaſs, furniſhed with common water, and leaving them in a quiet place, they were ſuffered to continue there many weeks; ſometimes they would be at the top of the water, and remain there for ſeveral days, or perhaps weeks; and ſometimes they would fall to the bottom, and after continuing there for ſome time, they would again emerge; and tho' at times they would riſe to the top, or fall to the bottom of the water, according as the air was hot or cold, yet it was not difficult to diſtinguiſh thoſe motions from thoſe produced by the varying gravity of the atmoſphere; for when the beams of the ſun, or the heat of the ambient air, by rarifying the air included in the bubbles, made that air drive out ſome of the water, and conſequently render the whole bubble, conſiſting of glaſs, air, and water, ſomewhat lighter than a bulk of water equal to it, and tho' the bubble did neceſſarily ſwim as long as the included air was thus rarified, yet when the abſence of the ſun, or any other cauſe, made the air loſe its adventitious warmth, there would again enſue a condenſation of the air, and thereupon an intruſion of more water, to ſucceed the air into the glaſs, and conſequently a ſinking of the bubble, and this would commonly happen at night, if not ſooner; but when the riſing and falling of the bubbles was owing to the varying weight of the atmoſphere, it appeared by the barometer that they ought to do ſo, in ſo much that it might be predicted, whether the mercury in the barometer ſhould be high or low, by obſerving the ſituation and poſture of the bubbles; and tho' the changes of air as to heat and cold, unleſs the atmoſphere were conſiderably either too light or too heavy, would place the bubbles ſometimes at the top, and ſometimes at the bottom of the water, within the compaſs of a day; yet if the atmoſphere were either very heavy, or very light, the bubbles would continue at the bottom or top of the water for many days together, in caſe the atmoſphere did not in all that time change its gravity.

Of the Sufpenfion of Mercury *at an unufual Height; by Dr.* Wallis. Phil. Tranf. N° 91. p. 5160.

IN the *Torricellian* experiment, the quickfilver contained in the inverted tube of what length foever it be, whofe open orifice C fig. 11. Plate XI. is immerfed in ftagnant mercury, does ufually fubfide to about 29 inches above its furface A B, and there remain fufpended as at I; but if the quickfilver be well cleanfed from air, it has been found to ftand top-full, even to the height of 75 inches; but upon the admiffion of the leaft air, or a fhaking of the tube, it falls down to the ufual ftandard. Dr. *Wallis* would account for this from the fpring of the air, which is neceffary to put heavy bodies in motion, that are not impelled by any other force; and my Lord *Brouncker* fuppofes, that there might be yet in the air a greater weight or preffure than this, neceffary for the height of 29 inches, in cafe there be nothing but the bare weight of quickfilver to be fupported; and with this M. *Huygens* feems to agree, fave that what the former denominates air, the latter calls a more fubtile matter: But Dr. *Wallis* thinks there muft be fomething more than this fubtile matter to folve the phænomenon, notwithftanding M. *Huygens*'s experiments in favour of it; for if this matter be fo fubtile as to prefs thro' the top of the glafs on the quickfilver, and confequently thro' the upper on the lower of the two marbles; it does not appear, why it fhould not balance itfelf above and below, in the fame manner as common air would do, if the tube were pervious to it at both ends, and the quickfilver, by the preponderancy of its own weight, fall prefently; and it does not folve the difficulty to fay, that tho' glafs be penetrated by it, yet not in fo copious a manner as where no glafs is, becaufe the fame obftacle does juft in the fame manner remain, when the tube is in part emptied, as when the quickfilver is not cleanfed, the pores of the glafs not being, by either of thefe, made more pervious; and if we fuppofe the fubtile matter to be ftrained thro' with fome difficulty, as air or water would be thro' a cloth, this might poffibly caufe the quickfilver, when it finks, to fink gradually, but not fuddenly to the height of 29 inches, as from D to I.

The connection or cohefion of the parts of mercury, either to each other, or to the fides of the glafs, which M. *Huygens* fuppofes to require for their feparation a greater force, than is in thefe percolated particles, till they have room made them to combine, feems the lefs confiderable, becaufe it is not fo neceffary

ceſſary to ſeparate them from each other, ſince they may unſeparated ſlide down by the ſides of the glaſs, to which it is well known, the quickſilver is not apt to ſtick; as water will not unite with oil or greaſe ſo that there needs no ſuch force to disjoin the mercury from the glaſs, whatever force may be requiſite for disjoining its parts from each other.

If therefore we ſhould ſuppoſe the preſſure of the groſſer air downwards on A B, the ſurface of the ſtagnant quickſilver, and conſequently by means thereof upwards at C, ſufficient only to ſuſtain the mercury in the tube to the height of I, but the ſuperadded weight or preſſure of the purer air to hold it up as high as D, 75 inches or more, when full, and the quickſilver well cleanſed, as if in all that time it could not enter at D; but in caſe the mercury be not ſo cleanſed, or be already ſunk to H, this purer air would enter at D, and thruſt it down to I, counterbalancing the preſſure at C of the purer, but not of the groſſer air, which ſeems to be the ſum of what M. *Huygens* advances; yet one muſt be at a loſs, why it may not as well penetrate D at firſt, to begin the deſcent of the mercury, as afterwards to purſue it; and why not as well begin the deſcent when the quickſilver is well cleanſed of air, as when it is not ſo; and why alſo, if the purer air do freely enter at D, it does not preſently fall; or, if not freely, why, when it falls, it falls ſuddenly, and not leiſurely from D to I: Dr. *Wallis* therefore would aſcribe the cauſe of this phænomenon to that ſpring of the air which is wanting in quickſilver; now ſuppoſing that a body at reſt will continue in that ſtate till it be put in motion by ſome force, which may be either that of percuſſion from ſome body already in motion, which is the caſe when the quickſilver falls by ſhaking or ſtriking the tube, or of pulſion from a contiguous body beginning to move, as by the expanſion of ſome adjacent ſpring, which is the caſe when the ſpringy parts of the air, either left uncleanſed, or re-admitted into the quickſilver, do by expanding themſelves put the quickſilver in motion; and therefore if quickſilver be not a ſpringy body, it cannot on that account put itſelf in motion.

My Lord *Brouncker* does a little alter the caſe from what ſeems to be M. *Huygen*'s hypotheſis; for he ſuppoſes this purer part of the air to be of a like nature with the groſſer; which M. *Huygens* does not, and tho' finer than the reſt, ſo as to penetrate glaſs, which the groſſer will not do, yet of a ſpringy nature like the groſſer air, which therefore acts not only by its weight, but alſo by its ſpring; and therefore when once entred, tho' in a ſmall

a ſmall proportion, it acts as effectually at its firſt entrance, as if the whole incumbent air had admiſſion, its ſpring being of a like tenſion with that of the external air; but tho' M. *Huygens* muſt allow his ſubtile matter weight; yet whether he makes it ſpringy does not appear; and when he ſays, that without difficulty it penetrates glaſs, water, quickſilver, and all other bodies, which are impenetrable to air; whether he mean, as the words ſeem to impart, without great difficulty, tho' with ſome, is not eaſy to determine: But his Lordſhip, tho' he allow his ſubtile ſpringy matter to penetrate glaſs, yet not without difficulty, and till it have ſome room made as at H D, wherein it may collect itſelf, it cannot exert its ſpring, and therefore not while top-full of cleanſed mercury; but it acts immediately as ſoon as ſome room is made for it; whereas, if the quickſilver be not purged of air, that little, which remains, does by its ſpring begin the motion; he alſo thinks it probable, and which, if true, will be a good confirmation of this hypotheſis, that a large but low tube of glaſs, ſhorter than 29 inches, may ſtand top-full of quickſilver, tho' with a ſmall hole at top, as at K, at leaſt if immerged in water; he might alſo ſuitably enough to his own hypotheſis have allowed his more ſubtile parts of common air to penetrate quickſilver, but not glaſs; and therefore in caſe of room for it at H D, it might paſs upwards thro' the ſtagnant quickſilver, and that at C, to H D, and there exert its ſpring.

There is yet another way of explaining the ſame hypotheſis, without allowing this ſubtile matter to pierce the glaſs, which is this; our common air being an aggregate of very heterogeneous parts, ſome of them may be ſuppoſed ſpringy, and others not ſo; the ſpringy parts may be conceived to be ſo many conſiſtent bodies, like ſmall hairs or ſpringy threads wrapped up in different forms, and variouſly entangled, ſo as to form many vacuities capable of admitting ſome fluid matter, which may inſinuate itſelf into thoſe vacuities, without diſturbing the texture of theſe ſpringy parts; and which may preſs as a weight, but not as a ſpring; now if in the *Torricellian* tube, there be a quantity of ſuch ſpringy matter, its ſpring will be equally ſtrong with that of the external air, and therefore able to counterbalance it, tho' its weight be much leſs, becauſe admitted with ſuch a tenſion; but if only an unſpringy fluid, which preſſes as a weight but not as a ſpring, and defended by the glaſs tube from any other preſſure, ſave that of its own weight, it will ſtill be too weak to force its own way, till its

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ſingle weight be equivalent to that which it is to encounter, which is not only the ſpringy part of the air, but alſo that fluid unelaſtic part, which, tho' on account of its fluidity, it would yield to a ſpringy body preſſing thro' it; yet not to this fluid that is like itſelf deſtitute of ſuch a ſpring, and is therefore able to ſuſtain it at a much greater height than it could do if freed of ſpringy air, ſo long at leaſt, till ſome ſpringy body be admitted, or ſome concuſſion equivalent to it, put it in motion; and being once in motion, it will continue in it, till ſtopped by ſome equivalent poſitive force: This explication may be ſubject to ſome difficulties and exceptions, but to fewer than that of allowing the glaſs penetrable by this ſubtile matter; but the beſt way to determine this matter is by ſuitable experiments.

A Diſcovery of two Planets *about* Saturn; *by M.* Caſſini. Phil. Tranſ. N° 92. p. 5178.

ABout the end of *October* 1671, *Saturn* paſſed cloſe by four ſmall fixt ſtars, that could only be ſeen by a teleſcope within the *Sinus* of the water of *Aquarius*; which *Rheita* took once for new ſatellites of *Jupiter*, calling them *Urban-octavians*; but *Hevelius*, who called them *Ulaſdiſlavians*, ſhewed they were ſome of the common fixt ſtars, that may every day be ſeen with a teleſcope any where in the heavens: This paſſage of *Saturn* gave occaſion to diſcover in the ſame place, within the ſpace of 10 minutes with a teleſcope of 17 foot, made by *Campani*, eleven other ſmaller ſtars, one of which, by its particular motion, ſhewed itſelf to be a true planet; and it was found to be ſo, by comparing it not only with *Saturn* and his ordinary ſatellite, diſcovered 1655 by M. *Huygens*, but alſo with other fixt ſtars; its motion was very manifeſt in reſpect of the fixt ſtars, but leſs ſenſible in reſpect of *Saturn*; yet it appeared, that from *October* 25th to *November* 1ſt, his diſtance from *Saturn* increaſed weſtward, and from that time to *November* 6th it diminiſhed; ſo that his greateſt digreſſion from *Saturn* happened in the beginning of *November*, which was found to be 8′, or 10 $\frac{1}{2}$ diameters of *Saturn*'s ring, and triple that of the ordinary ſatellite; and hence it was judged, that the time of his revolution was quintuple, applying to the ſatellites that proportion, which *Kepler* hath remarked in the primary planets, between the periodical times and their diſtances: *Dec.* 16th, *Saturn* had reſumed his round figure, and to the eaſt of him was a ſmall ſtar at a great diſtance in a ſtreight line with *Sa-*

 turn,

turn, and his ordinary ſatellite, which was alſo oriental, but at a ſmall diſtance from *Saturn*. *Dec.* 24th, this ſatellite was ſeen in the weſt, and an oriental ſtar leſs diſtant from *Saturn* than that ſeen the 16th.

Dec. 13th and 17th, 1672, with an excellent teleſcope of 35 foot, made by *Campani*, an occidental ſtar, remote from *Saturn*, was obſerved, which in both theſe obſervations had a ſouthern latitude in reſpect of the line of his wings; but in the firſt it was further diſtant from *Saturn* than in the ſecond; ſo that if this was the ſame ſtar, it moved towards *Saturn* on the eaſt, and conſequently, ſuppoſing it to be its ſatellite, it was in the ſuperior part of its circle.

Feb. 6th, 1673, it was ſeen again, and all the following days to the 20th; this new planet removed more and more from *Saturn*, till the 19th of *Feb.* when the difference between his paſſage and that of the centre of *Saturn* was 30″ of an hour, which gave at leaſt 10 diameters of *Saturn*; and on the 20th, the diſtance was judged by eſtimation to be greater: By the apparent ſwiftneſs of his motion during the firſt days, it was very eaſy to ſee that this planet had been in conjunction with *Saturn* *Feb.* 3d, 1673; and by his motion to the weſt, it appears, that he was in the inferior part of his circle; and becauſe during this time of 17 days, he removed more and more from *Saturn*, 'tis certain that he remained in the ſame quadrant of the inferior occidental circle above 17 days, and that his whole revolution is more than 68 days: He was theſe laſt days at a diſtance almoſt equal to that which he had about the end of *Octob.* 1671; ſo that in 480 days, or thereabouts, he made a certain number of entire revolutions, which can be no more than 7, ſince each of them is queſtionleſs more than 68 days; if you ſhould count 7 of them, each would be 68 ½ days, if you reckon 6, each would be 80 days, if but 5, each would be 96 days; but this laſt ſuppoſition can by no means be made to agree with the two obſervations of *December* 1672, and the firſt does not agree ſo well with them as the ſecond.

Dec. 23d, another ſmall ſtar was found weſtward of *Saturn*, between him and his ordinary ſatellite, which was alſo on the weſt, almoſt at a double diſtance; *Dec.* 30th, a ſmall ſtar was ſeen to the eaſt of *Saturn*, without any latitude between him and his ordinary ſatellite, which had alſo paſſed to the eaſt of him; *Jan.* 10th, 1673, this little ſtar appeared to have returned almoſt to the ſame poſition in reſpect of *Saturn* and his ordinary ſatellite, where it had been *Dec.* 23d; *Jan.* 15th, the

the ordinary ſatellite was oriental, and the new one occidental, as it had been in the preceeding, but a little nearer to *Saturn*; that ſame evening this planet was obſerved for an hour together, in which time it approached to *Saturn* on the weſt, and conſequently it was in the ſuperior part of his circle, which confirmed it to be an interior ſatellite; thus the purſuit of another ſatellite, which was at a greater diſtance from *Saturn*, and had a longer period, gave occaſion of diſcovering this, which is nearer, and whoſe period is ſhorter; then it was, that comparing the obſervations together, the rule of the motion of the new interior planet was found; for the two laſt ſhewed, that in five days he had made more than a whole revolution; by the firſt obſervation compared with the third, it was judged that in 18 days he had made a number of revolutions, almoſt whole ones, which were four, each of them of four $\frac{1}{2}$ days; ſo that between the 10th and 15th it might be, that there had been one revolution of four $\frac{1}{2}$ days, or two revolutions of two $\frac{1}{4}$ days each; but the combination of the firſt with the ſecond, cauſed him to ſeclude the period of two $\frac{1}{4}$ days; it was therefore judged by theſe obſervations, that this laſt planet finiſhes its revolution about *Saturn* in four $\frac{1}{2}$ days; that the ſemidiameter of his circle is of 1 $\frac{5}{8}$ of the diameter of *Saturn*'s ring; that he was towards his greateſt occidental digreſſion, *Dec.* 23d, and *Jan.* 1ſt, about ſeven o'clock in the evening.

The Volatilization of Salt *of* Tartar *and other fixt* Salts; *by Dr.* Von der Becke. Phil. Tranſ. N° 92. p. 5185.

THIS learned author, having exploded the uſeleſs and empty terms of faculties, qualities, *&c.* and recommended the inveſtigation of nature by experiments guided by reaſon; endeavours to ſhew, firſt, the cauſes of the fixation of the ſalt of tartar; ſecondly, the reaſons of the volatilization; thirdly, what degree of volatility the ſalt of tartar hath acquired in that fermentation made with its own ferment.

As to the firſt, he blames thoſe that divide ſalt into fixt and volatile, that diviſion, in his opinion, being unknown to nature; there not being any fixt ſalt to be formally found in any body before calcination; ſuch as the alcalizate ſalt of tartar and other fixt ſalts are, produced by calcination; he therefore informs us, that ſalts that are volatile before inceneration, are by the action of the fire ſo colliquated among themſelves and with the earthy particles, as to become fixt thereby; for the clearing of which, he ſuppoſes, with ſome others, that

there are two kind of ſalts, *viz.* an *Alcali* and an *Acid*, as the genuine inſtruments of nature in the germination of plants, the firſt conceptions of animals, and in all the beginnings of fermentations; and theſe two ſalts he affirms to be volatile, and therefore eaſily reſolvable by the ſalt of the air; ſince it appears, that all vegetables, eſpecially aromatics, if they be any conſiderable time expoſed to the air loſe their ſalts; and that wood in particular, by the action of the air conſuming the volatile ſalt, does in time quite moulder away: Whilſt therefore theſe ſalts are looſened, and ſet at liberty by the fire, elſe they would not act, they begin to operate on each other; the volatile ſalt working on the volatile *Alcali*, fixes it, and they are colliquated together; which operation of nature being well obſerved, it will be manifeſt, that that received axiom is falſe; *viz.* things volatile are fixed by thoſe that are fixt, and things fixt rendered volatile by thoſe that are volatile: Now that volatile ſalts are conſumed by the air, and colliquated by fire, is ſo notorious, that common people are wont to ſink in water ſuch timber as they would preſerve from putrefaction, thereby to keep it from the air, and to harden it to a greater degree for ſtrong ſupports of buildings; hence alſo they ſlightly burn the ends of timber to be ſet in the ground; that ſo by the fuſion made by fire, the volatile ſalts, which by the acceſſion of the moiſture of the earth would eaſily be conſumed to the corrupting of the timber, may fix each other; for which reaſon alſo, *viz.* the fuſion of the volatile ſalts, ſhip-carpenters are wont to burn the lowermoſt parts of ſhips, that lie under water; and to uſe a very common inſtance, it is known, that whilſt wood burns, the ſmoke aſcends wherein the two volatile ſalts are contained, that coagulate each other into ſoot; which ſalts may again be eaſily ſeparated; and theſe volatile ſalts, conſtituting the ſmoke and ſoot, riſe till the wood is reduced to aſhes, in which the remaining volatile ſalts are colliquated to a fixt ſalt, to be eaſily waſhed out with water; theſe two volatile ſalts do therefore afford the matter, of which the fixt ſalt is made by means of the fire; whence it is evident, that ſo much the more fixt ſalt is obtained, which really happens, the more volatile ſalt the mixt body contained before incineration; as alſo why freſh herbs burnt to aſhes yield a greater quantity of fixt ſalt than dry, becauſe the air robs them of the greateſt part of their volatile ſalts; and on the ſame account, decayed and mouldered wood contains almoſt no fixt ſalt, having alſo loſt its weight.

After

After having thus ſhewn, that no fixt *Alcalizate* ſalt is to be found in mixt bodies before incineration; and how the volatile ſalts are by calcination brought to fuſion and ſo fixed; the author, in order to a further proof of the fixation of ſuch volatile ſalts, takes notice of the mixture of earthy parts in ſuch bodies; ſome of which, when theſe two volatile ſalts thus opened by the fire act on each other, are coagulated with them; which he conceives to be the caſe, when theſe two ſalts, being concreted in the kidneys, do by their aſperities wound the blood veſſels, whence the nephritic pain; and ſo coagulate together with themſelves the extravaſated blood, which makes the ſtone in the kidneys reddiſh, as that of the bladder is whitiſh from the mucous ſubſtance of that part; and ſo he obſerves that the ſtones concreted in the gall-bladder are of a bitter taſte: When this earth is by the fire intimately united with the ſalts, and has been in a manner vitrified with them, it unites them ſo cloſe, that they can no more riſe and fly away; and the ſalts are rendred ſo fixt, that a gentle fire does not touch them, a ſtrong one brings them to fuſion, and by an extreme degree of heat they are vitrified; ſo if you mix fixt ſalt of tartar with cinnabar of antimony, or with quickſilver, all the quickſilver, tho' a very ponderous body, will paſs into the retort, but the ſalt of tartar, by reaſon of its earth, will remain at the bottom of the veſſel; whence he thinks it evident, that the fixt *Alcali*'s, eſpecially that of tartar, cannot, on account of the colliquation of the earthy parts, penetrate into bodies to be diſſolved, nor conſequently remove the inmoſt ſeeds of diſeaſes.

Now, in the ſecond place, tho' the volatilizing ſuch fixt ſalts, and particularly that of tartar, has been hitherto found very difficult; yet our author conceives, it would be very eaſy, if we took nature for our guide, and if we ſeparated from ſalt of tartar the fixing earth, that hath been proved to be mixed with it; for the doing of which, he would, according to Dr. *Langelot*, mix the fixt ſalt of tartar with its genuine ferment, *viz.* crude tartar; or, if in the fermentation you have a mind to ſee the grape-like bubbles, with cream of tartar, and ſo be expoſed to fermentation; in which commixture he would have this eſpecially obſerved, that it be done to a degree of ſaturation, and till the fermenting agitation, and the motion of the ſaline particles do ceaſe; which is a ſign that all the particles of the fixt ſalt of tartar are conjoined with the acid particles of the crude tartar, or its cream; and all the parts of the

the crude tartar ſaturated with the fixt ſalt; and this being obſerved, the diſtillation will be more ſecurely executed: The author is entirely perſuaded that in his fermentation of tartar, it is not chiefly the very fixt alcali of tartar that is again volatiliz'd, but rather the ſuperadded ferment, which is the crude tartar; now, tho' the fixt alcali of tartar be in this fermentation freed from that earth, to which by the fuſion of the fire it was intimately united, yet notwithſtanding, it is fixed again, by the acid of the tartareous ferment; for the proof of which, he makes uſe of the urinous ſpirit of ſal-armoniac, in which there are two volatile ſalts, an urinous and an acid; theſe two ſalts, tho' volatile when ſeparated, yet when united detain each other, in the ſame manner as fixt ſalts; ſince they are neither diſſolved in the air, nor emit any odour, like true volatile ſalts: Now to obtain the urinous volatile ſpirit, water is poured upon the ſal-armoniac, and then a fixt alcali is added, which uniting with the acid portion of the ſal-armoniac, the volatile urinous part is joined with the water, and yields a very volatile and penetrating ſpirit, which ſtrikes the noſe very ſtrongly; tho' before the mixture of the fixt ſalt, the ſal-armoniac was entirely ſcentleſs; wherefore, as in ſal-armoniac, the fixt ſalt ſets free the alcalizate portion of the ſalt; ſo in this fermentation of tartar, the tartar calcined to blackneſs, or the fixt ſalt of tartar does ſet looſe the alcalizate part of the crude tartar from the acid part: If therefore to this tartar, pregnant with ſalts, crude or depurated by a ſolution in water, you add a calcined tartar, or ſalt of tartar itſelf; this fixt ſalt will immediatly lay hold on the acid portion of the crude tartar; and as in the ſal-armoniac, ſo here, it will ſet free the volatile alcalizate, and from the conflict and action of the ſalts on each other, grape-like bubbles will ariſe; and this injection of calcined tartar muſt be continued, till all fermentation doth ceaſe; that is, to the very degree of ſaturation; but this volatile alcali, being by the calcined tartar freed from its acid, like the urinous of the ſal-armoniac, will preſently fly away: Wherefore, if this volatile ſpirit could forthwith be received, it would afford a real volatile ſalt of tartar; eſpecially if freed from its phlegm, which makes it a fluid ſpirit, and without the addition of any thing foreign, coagulated into ſalt; but this cannot be done, ſince this mixture cannot be put into the cucurbit before the fermentation is over, becauſe it would elſe break the veſſel; nor can the fixt be all at once added to the diſſolved crude tartar, but at ſeveral times, becauſe all the fer-

fermented part would quickly get out at the edges of the cucurbit; now ſince by the addition of fixt ſalt, there is every time ſo much of the volatile acid ſet free from the crude tartar, in proportion to the addition of fixt ſalt, and that preſently it flies away; it certainly follows, that if by injections, ſeveral times repeated, you come at laſt to the point of ſaturation, there will remain no volatile alcalizate ſalt of the crude tartar: Since then there is no hopes of obtaining the volatile ſalt from crude tartar this way, we muſt endeavour to get it by an addition of tartar calcined, or fixt ſalt; and how this is to be done, has been already hinted, *viz.* by the ſeparation of the earthy parts; for as the volatile alcalizate particles, upon a very vehement colliquation of the fire, are, by an intimate union with the earthy parts, kept from aſcending; ſo alſo, when freed from theſe terreſtrial fetters, they are reſtored to their former freedom and volatility; and this ſeparation of the earth is obtained by this fermentation of the tartar; for in the ſame manner that the acid portion of the crude tartar is conjoined with the fixt ſalt of tartar, to ſet the volatile alcali of the crude tartar at liberty; there is alſo made a precipitation of that inſipid earth, which, by the extreme degree of fire, was united with the ſalt of tartar, and had fixed it before: But to give an ocular demonſtration of this fixing earth, he alledges the example of vitriolate tartar; in this operation, while the ſpirit of wine is a pouring on the diſſolved ſalt of tartar, or its oil made *per deliquium*, you may obſerve a very great efferveſcence; during which, and the action of the acid of the vitriol upon the alcali of the tartar, an earth is precipitated, which may be afterwards ſeparated by filtration; now that this earth is precipitated from the ſalt of tartar and not from the ſpirit of vitriol, is plain; and ſome call it the magiſtery of vitriolate tartar, and often very improperly prefer it in their preſcriptions to the true vitriolate tartar itſelf; it is true, this earth has a ſaline taſte, but theſe ſalts as is uſual in all precipitations, only adhered to the precipitated matter, and may by a repeated ablution be eaſily ſeparated; after which there remains nothing but an inſipid earth, which can have no other virtue than that of exſiccating; wherefore after the ſame manner, while the acid part of the crude tartar is united with the alcalizate of the ſalt of tartar, the earth alſo of the fixt ſalt of tartar in the ſaid fermentation will be precipitated.

The greateſt difficulty being thus diſpatched, our author proceeds in the third place to a leſſer; which is, that the acid part, by

by means of which the earth was precipitated, detains the volatile alcalizate part, and fixes it a-new; ſo that his volatile ſalt of tartar has hitherto acquired no greater degree of volatility than crude ſal-armoniac, or its flowers are known to have; for theſe, tho' they conſiſt of volatile parts, yet they diffuſe no odour before the ſeparation of the volatile parts; and they alſo endure the air, which no volatile ſalts, truly ſuch, will do; wherefore they cannot yet be reckoned among volatiles, ſtrictly ſo called: Now to give this volatile alcali of tartar the laſt and higheſt degree of volatilization, the author thinks it neceſſary, there ſhould be made a new addition of fixt ſalt of tartar, which in the ſame manner, as before it had ſet free the alcalizate part of crude tartar from its acid, muſt here alſo take from the manifeſt acid of crude tartar the alcalizate part of the fixt ſalt of tartar, already freed from earth; whereby this alcalizate part of the ſalt of tartar truly volatilized, being joined to the water, will conſtitute a very volatile ſpirit, which, he ſays, may be coagulated, without addition, into volatile cryſtals, having the perfect taſte of tartar.

The Nature of Snow; *by Dr.* Neh. Grew. Phil. Tranſ. N° 92. p. 5193.

A Diligent and careful obſerver will with Dr. *Hook* and *Des Cartes*, find, that many of the parts of ſnow are of a regular figure, and for the moſt part, as it were, ſo many little rowels or ſtars with ſix points, which are perfect and tranſparent ice, as any we ſee on a pool or veſſel of water; on each of theſe ſix points, are ſet other collateral points, and theſe always at the ſame angles with the principal points themſelves: That amongſt theſe regular figures, many others alike regular, but far ſmaller, may likewiſe be diſcovered: That being ſtill more attentive, we ſhall perceive, that there are divers others, which are indeed irregular, yet chiefly the broken points, parcels, and fragments only of the regular ones: That beſides the broken parts there are ſome others, which ſeem to have loſt their regularity, not ſo much in being broken, as being by various winds firſt gently thawed, and then freezed again into little irregular maſſes: From all which, ſnow ſeems to be an infinite number of icicles regularly figured, not only in ſome few parts thereof, but originally in the whole body of it; not ſo much as one particle of ſo many millions being originally indeterminate or irregular; that is, a cloud of vapours being gathered into drops, theſe drops do forthwith deſcend; in which

defcent meeting with a freezing wind, or at leaft paffing thro' a colder region of the air, each drop is immediately frozen into an icicle, fhooting itfelf into points or icicles on all fides from the centre; but ftill continuing their defcent, and meeting with warmer air; fome are thawed and blunted, others broken, but the greateft number cling together in feveral parcels, and form what we call flakes of fnow: Hence we underftand why fnow, tho' it feem to be foft, is really hard, becaufe it is a real ice, whofe infeparable property it is to be hard; and its foftnefs is only apparent, the firft touch of the finger upon any of its fharp edges or points inftantly thawing it, otherwife thefe points would pierce our fingers like fo many lancets: And again the reafon appears, why, fnow, tho' a real ice, and fo a hard and denfe body, is notwithftanding very light, which is the extreme thinnefs of each icicle in refpect of its breadth; for fo gold, tho' the moft ponderous of all bodies, being beaten into leaves, rides on the leaft breath of air; and thus it is in all other bodies, whofe furfaces exceed their quantity of matter: Hence it alfo appears why fnow is white, which is, becaufe it confifts of parts, each of which fingly is tranfparent, but mixed together, appear white; as the parts of froth, glafs, ice, and other tranfparent bodies, whether foft or hard.

The effential nature of fnow may be beft underftood, by comparing its general figure with the regular figures of feveral other bodies; for from a like configuration we may probably infer a like fubject, and a like efficient: As to the figure of fnow, it is generally one, as that above defcribed; and it is rarely of different figures, but when it is, they may be reduced to two, *viz.* circular and hexagonal, either fimple or compounded; it happens rarely that they have more than fix points, but if they exceed that number, then the points are not 8 or 10, but 12; or they appear in fingle fhoots, as fo many fhort flender cylinders, like thofe of nitre; or in one fhoot, which, like an axel-tree, is inferted into a pair of icicles, as the two wheels; or laftly, they appear of the fame hexagonal figure, of the fame ufual breadth, but of a continued thicknefs, like the ftone *Boethius* calls *Aftroites*; yet all thefe figures are rare, the firft that was defcribed being the general figure.

The configurations of other bodies are fome more, fome lefs refembling icicles; nitre is formed, as is commonly known, into long cylindrical fhoots; as alfo generally all lixivial falts, refembling, tho' not perfectly, the feveral points of each ftarry icicle of fnow; falt of hart's horn, fal-armoniac, and fome other

volatile ſalts, beſides their principal and longer ſhoots, have ſhorter ones that branch out from thoſe; but the cryſtals of urine have ſtill a nearer reſemblance; for tho' in ſalts of hart's-horn, the collateral ſhoots ſtand at acute angles with the principal, yet not in pairs, and at equal heights; and in ſal-armoniac, tho' the ſhoots ſtand diametrically oppoſite, or at equal heights, yet withal at right angles; whereas in the icicles of urine they ſtand both at equal heights and at acute angles; in both theſe circumſtances reſembling ſnow; and it is obſervable, that the configuration of feathers is likewiſe the ſame; the reaſon of which is, that fowls, having no organs for the evacuation of urine, the urinous parts of their blood are diſcharged by the habit or ſkin, where they both produce and nouriſh feathers.

From hence it ſhould ſeem that every drop of rain contains ſome ſpirituous particles, which, meeting with others in their deſcent, of a ſaline nature, partly nitrous, but chiefly urinous, or of an acid ſalinous nature, do faſten on them, and thereby the whole drop is fixed, not into any indifferent and irregular ſhape, but figured into a little ſtar.

Of the Cacao-tree *in* Jamaica. Phil. Tranſ. N° 93. p. 6007.

THE trunk of the cacao-tree is commonly about four inches in diameter, five foot high, and above twelve from the ground to the top of the tree; theſe trees differ exceedingly among themſelves; for ſome ſhoot up into two or three trunks, others again into one; many of their leaves are dead, and generally diſcoloured, unleſs on very young trees; they are not quite ſo agreeable to the eye, as the fruit is to the lovers of chocolate: The number of cods this tree produces, is uncertain; but a bearing tree yields from two to eight pounds of nuts a year, and each cod contains from twenty to thirty nuts.

The manner of curing theſe nuts is, to cut them down when they are ripe, and lay them on heaps for three or four days, that they may ſweat in the cods; after this the cods are cut open, and the nuts taken out, and put into a trough covered with plantain-leaves, where they ſweat again for ſixteen or twenty days; the nuts in each cod are knit together by certain fibres, with a white kind of pulp about them, that is agreeable to the palate; by the turning and ſweating, their little ſtrings are broken, and the pulp is imbibed by the ſubſtance of the nut, and mingled with it; after this they are ſet to dry in the ſun for three or four weeks, and then they become of a reddiſh dark colour: What is remarkable in this fruit is, that the cods

grow

grow only out of the body, or great limbs and boughs; and that at the ſame time, and in the ſame part of the tree, are both bloſſoms, and young and ripe fruit: Theſe trees bear in different ſeaſons, as ſome moſt plentifully in *December* and *January*, and others in *May*; tho' theſe ſeveral trees are at no great diſtance from each other; and ſuch as bear moſt plentifully in *December* have ſome fruit in *May*, and on the contrary.

The cacao-trees are at firſt reared from the nuts, which are always planted in the ſhade, either under caſſave, plantain-trees, or in woods; the *Spaniards* are wont to lay them under a certain large ſhady plant, called by them *Madre de Cacao*: The tree is ſeldom tranſplanted, unleſs where it happens to fail; and it often does ſo in open, poor, and dry lands; for this tree muſt be ſheltered from the ſun while young, and at all times from north-eaſt winds; and it requires a fat, moiſt, and low ſoil, on which account they are commonly planted by rivers and between mountains; ſo that it is unwholeſome to live where there are good cacao-walks: In a year's time the plant arrives at the height of four foot, with leaves ſix times larger than thoſe of an old tree, which, as the plant grows bigger, fall off, and ſmaller leaves ſucceed.

The trees are commonly planted at twelve foot diſtance; and at three years old, when the ſoil is good, and the plant thriving, it begins to bear a little, and then the whole or only ſome of the ſhade is cut down; and ſo the quantity of fruit encreaſes till the 10th or 12th year, and then the tree is ſuppoſed to be in its prime; how long it may continue ſo, cannot be conjectured; but it is certain that the root ſends forth ſuckers, that ſupply the place of the old ſtock, when it either dies or is cut down, unleſs any ill quality of the ſoil or air kill them both.

Cacao was originally the wild growth of the *Weſt-Indies*: It paſſes for money in *New Spain* and the ſilver-countries.

The Advantages in Virginia *for* Building *of* Ships. Phil. Tranſ. N° 93. p. 6015.

THE country of *Virginia* all over abounds with large and tall oaks, at leaſt 50 or 60 foot high, of clear timber without branches, and very fit for making plank of any ſize, being very tough, and extremely well enduring the water.

No other country in the world is better ſtored with pine for maſts; beſides another ſort of wood, called *Cypreſs*, which ex-

ceeds any pine, being as tough and ſpringy as yew, and capable of being bent to any degree; and when dry, it is much lighter than fir; and ſo laſting, that it ſeems rather to poliſh than periſh in the weather.

Virginia affords great numbers of old pine for making roſin, pitch, and tar: And it might alſo yield the conveniency of planting hemp for cordage and ſail-cloths: To which we may add the great plenty of iron-ſtone, which have been found very good; and the conveniency of wood and lime-ſtone for making iron, which might be done at a much cheaper rate there than in *England.*

A Way of making Vines *grow over the Roof of a Houſe; by Mr.* J. Templer. Phil. Tranſ. N° 93. p. *6016.*

LET the vines aſcend by one ſingle ſtem to the eaves of the houſe, and cut off all the luxuriant branches; then give them liberty to ſpread over the tiles on one ſide of the houſe; by this contrivance the vines are no hindrance to the other wall-fruit, and the rays of the ſun being almoſt direct upon them, the grapes will become riper, ſweeter, and they will be in greater plenty than when the vines are placed as wall-trees.

The Motion of the Hearts *of two* Urchins; *by Mr.* J. Templer. Phil. Tranſ. N° 93. p. *6016.*

MR. *Templer* cut out the hearts of two urchins, and he found the ſyſtole and diaſtole to continue full two hours, while the hearts lay on an earthen white plate in a cold window; the ſpace of time between the diaſtoles was unequal, but very large for half an hour, and then ſenſibly diminiſhing, till they ceaſed at the end of two hours, when they could not be made to move by the prick of a needle; yet upon ſetting the plate upon the hearth in the chimney, in about two minutes they began to beat, tho' but weakly, and after eight minutes they beat freely, and when removed into the window again, they continued their pulſation without pricking above an hour, and might have done ſo longer, if they could have been attended on: We may hence make a probable conjecture at the cauſe of life and death: But when ſhall we ſay any animal or inſect is dead, if it continue to have motion?

Obſervations in Turky. Phil. Tranſ. N° 93. p. 6017.

THERE is a diſeaſe which reigns in the country about *Aleppo*, and as far as *Bagdat*, not ſparing any age or ſex, and invading as well ſtrangers as natives; it is popularly called *Il male d' Aleppo*, and appears in the ſkin as a ſmall puſtule or wheal, hard and red, whoſe head at firſt is ſcarce bigger than the point of a pin; it grows afterwards bigger, and continues growing for ſix months, and it is fed by five or ſix little roots or fibres; in ſix months more it declines again, ſo that the whole period of this diſeaſe is generally compriſed within the compaſs of a year: This puſtule has hitherto been ſo far from yielding to any remedies, either in the beginning, middle, or declination, that they rather exaſperate it, tho' they are anodynes; this diſeaſe is wholly to be left to nature, and if you do ſo, there is no pain or trouble in it; it ſeizes not only once but ſeveral times the ſame perſons, and in ſeveral parts of the body; and if it fall on the face, as it often does, it cauſes a remarkable ſcar, which notwithſtanding gradually diſappears.

Fevers tho' they have the ſame ſymptoms as in *England*, yet there are two things peculiar in them; one is, that in acute fevers, a cold ſweat commonly ſignifies recovery, but a hot ſweat portends death; the other is, that in ſuch acute fevers, even an intermitting pulſe threatens no danger.

The leproſy, which formerly was ſo rife in theſe countries is now hardly known there, tho' there is ſtill at *Damaſcus* an hoſpital for ſuch patients.

The reaſon, why *Conſtantinople* is ſo ſubject to the plague is, according to ſome, owing to the number of ſlaves which are yearly brought from the *Black Sea*, and to their hard diet and uſage; and others are of opinion, that the common people there feeding on melons and cucumbers for the greateſt part of ſummer, and drinking water upon them, fall into malignant and peſtilential fevers; but phyſicians generally hold that the air of *Conſtantinople* is infected by the north-eaſt winds, which commonly blow for three months, beginning about the ſummer-ſolſtice; which riſing from unwholeſome marſhes in *Tartary* and *Muſcovy*, and paſſing over the *Black Sea*, a place abounding in fogs, carry along with them certain diſpoſitions tending to corruption, which affecting bodies already prepared by bad diet, may well be judged to be the cauſe of this diſtemper.

Beſides the other uſes of opium in *Turky*, it is common in *Arabia* to cure the griping of the guts in horſes therewith.

As

As to the way of dreſſing leather in *Turky*, it is to be obſerved, that their leather is not near ſo ſtrong and ſerviceable as the *Engliſh*; and tho' it be commonly reported, that the leather in theſe parts, tho' thin and ſupple, will hold out water, yet this is owing to their putting a cere-cloth between the lining and the leather of their winter-boots: In dreſſing their leather they uſe lime and *Album Græcum*, and inſtead of bark, *Valonia*, a ſort of acorn growing on the oak; and the *Engliſh* acorns might have the ſame effect, and to better purpoſe; for the *Valonia* burns the leather, whereas the former may probably be more temperate,

The Synchroniſm *of the* Vibrations *in a* Cycloid. Phil. Tranſ. N° 94. p. 6032, *Tranſlated from the* Latin.

LET Plate XI. Fig. 12. ab, bc, cd, de, ef, *&c.* be mutually equal; and $b\,1$, $c\,2$, $d\,3$, $e\,4$, $f\,5$, *&c.* increaſe equally, as the numbers, 1, 3, 5, 7, 9, *&c.* I ſay, that any heavy body falling from any point of this line will reach the loweſt point in the ſame ſpace of time, in which it would reach it, did it fall from any other point of the ſame line; for if you ſuppoſe $a = ab = bc = cd$, *&c.* and $b = b\,1$, and x be the number of times either of them is taken; then if xa be put for af, xxb muſt ſtand for $f\delta$, and conſequently the time of deſcent will neceſſarily be $\frac{xxb}{xxaa}$ or $\frac{b}{aa}$; and the ſame thing holds in all caſes, therefore, *&c.*

I ſay further, that this curve is the cycloid, which is eaſily demonſtrated from the conſtruction, and from what was juſt now hinted, *viz.* that this curve $abcdefz$ is equal to twice the laſt of the right lines, that is, to $2\,z\omega$, and that $a\omega$ is equal to half the circumference of a circle whoſe diameter is $z\omega$; and univerſally, that the triangle ♈ ♉ ♊ repreſents the right line $z\omega$, the ſquare ♈ ♉ ♊ ♋ the curve $abcdefz$, and that the quadrant ♈ ♉ ♋ repreſents the right line $a\omega$, and the parts of one reſpectively the parts of the other; as if ♈ ♎ ♍ repreſent $f\delta$, then ♈ ♎ ♌ ♋ repreſents $a\delta$, and ♈ ♎ ♏ ♋ repreſents af: And in a word, that a ball ſuſpended from a ſtring of a due length and vibrating between two cycloids, does move in a cycloid; wherefore theſe vibrations are performed in the ſame time. Q.E.D.

Micro-

Microſcopical *Obſervations*; *by M.* Leewenhoeck. Phil. Tranſ. N° 94. p. 6037.

M. *Leewenhoeck* obſerved that mouldineſs on ſkin, fleſh, or other things, ſhoots up firſt with a ſtreight tranſparent ſtalk, in which a globular ſubſtance riſes, that generally ſettles at the top of the ſtalk, and is followed by another globule, driving out the firſt either on the ſide, or at the top; and that again is ſucceeded by a third, *&c.* all which form on the ſtalk one great knob, a great deal thicker than the ſtalk itſelf; and this large knob burſting aſunder repreſents a kind of bloſſoms with leaves.

The ſting of a bee he obſervd to conſiſt of two other ſtings, lodged within the firſt, with each its peculiar ſheath: He further obſerved anteriorly on the head of a bee two inſtruments with teeth, which he calls ſcrapers, becauſe he ſuppoſes that with them the bee ſcrapes the waxy ſubſtance from the plant; beſides two other parts, which he calls worms, wherewith he thinks the animal works and makes the combs; there is likewiſe a ſmall body, which he calls the wiper, which is rough, and exceeds the other members in thickneſs and length, by which he thinks the bee gathers the honey from the plants; all which organs when ſhe gives over working ſhe ſkillfully ſheaths up in good order under her head: As to the eye of the bee, it receives the light juſt with the ſame ſhade as honey-combs are ſeen; whence he ſuppoſes that the bee works not by art or ſkill, but only after the patern of the light received by the eye.

He obſerved in a louſe a ſhort tapering noſe with a hole in it, out of which it exerts its ſting, when it would ſuck blood, which is a great deal finer than any ſingle hair; the head is without any ſutures, and the ſkin is rough; in the two horns are five joints; one claw of the foot reſembles that of an eagle's, but the other of the ſame foot ſtands ſtreight out, and is very ſmall; and between theſe two claws is a raiſed part or knob, the better to hold faſt the hair.

Of an Eſſence for ſtaunching Blood; *by M.* Denys. Phil. Tranſ. N° 94. p. 6039.

THIS eſſence, being applied to any artery whatſoever, ſtops the blood inſtantly, without binding up the wound; the firſt trials were made on dogs, whoſe crural and carotid arteries were cut, and the blood was ſtopped in a little time, the

the wound healing without any ſcar or ſuppuration: Some experiments were alſo made upon men, and it ſucceeded as well as in dogs. This liquor taken alſo inwardly ſtops inveterate fluxes of blood.

The Vaſa Teſticularia *of a Beetle; and the* Vena Arterioſa *not found in ſome Animals that have Lungs; by Dr.* Swammerdam. Phil. Tranſ. N° 94. p. 6040. *Tranſlated from the* Latin.

THE ſtructure of the *Vaſa Teſticularia* of a *Naſicornis* beetle agrees exactly with that of the human teſticles, it being obſerved to conſiſt of one only rope, which is long, hollow, and with innumerable folds; but they have a blind beginning or extremity, which is not obſerved in thoſe of a man. Their length is two foot ſix inches; and the *Vaſa deferentia*, when wounded, diſcharge a copious white *Semen*; there are beſides ſix veſicles or rather ſeminal glands, whoſe ducts, in the ſame manner as in men and brutes, contain a yellowiſh ſeminal ſubſtance.

Tho' frogs, which are amphibious animals, are allowed to have lungs, yet they are deſtitute of the *Vena Arterioſa*; wherefore their blood does not circulate thro' the lungs, nor is it there comminuted, but is propelled thro' the whole body from the one ſingle ſinus or ventricle of the heart; which may afford no contemptible argument for reſtoring to the liver the office of ſanguification: Yet there is a manifeſt artery, analogous to the *Bronchial* or rather pulmonary, in the coat that envelopes the lungs of frogs, which in a ſurpriſing manner, and like a net, is extended over their whole ſubſtance, and with its minute ramifications proceeds to the moſt internal veſicles, where it is thought to communicate with the pulmonary vein, and even in a manner manifeſt to ſight; and that venal veſſel is twice larger than the arterial, ſituated in the cavity of the lungs, and eſpecially in the extremities of the veſicles; from whence it ſupplies all the cells and even the ſurrounding tunicle with capillaries and almoſt inviſible ramifications.

Dr. *Swammerdam* ſuſpects that toads, lizards, ſerpents, cameleons, ſnails, and water-ſalamanders have the ſame ſtructure of lungs with frogs; as alſo all other animals that have membranous lungs.

Ex-

Experiments made with a Liquor for ſtaunching Blood; *by Dr.* Needham, *and M.* Denys. Phil. Tranſ. N° 95. p. 6052.

AFTER having laid bare the jugular vein of a dog, and opened it with a lancet, and then immediately applying to it a button pledget of lint dipt in this ſtyptic, which was ſent from *France*; and opening alſo the carotid artery, and applying a pledget after the ſame manner, keeping it on by the preſſure of the thumb for about $\frac{1}{4}$ of an hour, they were then taken off, and the veſſels bled, but not freely; but renewing them, and keeping them on for a $\frac{1}{4}$ of an hour longer, both the vein and artery were united.

A young woman's breaſt being cut off, the arteries were ſtopped by holding the like pledgets in their mouths, whilſt the dreſſings for the breaſt were preparing; and then the pledgets being removed, the blood continued ſtaunch and the mouths of the arteries were cloſed.

The crural artery of a dog was quite cut thro', and a compreſs of lint dipt in the liquor was immediately applied to it, and in a quarter of an hour the wound was found dry: Upon cutting off a dog's leg, and applying a compreſs of lint dipt in the ſtyptic to the veins and arteries, in a quarter of an hour, the compreſs was taken off, as alſo the bandage, and the blood was entirely ſtaunched.

The Demonſtration of M. Sluſius's *Method of drawing* Tangents *to any Curves, without the trouble of Calculation.* Phil. Tranſ. N° 95. p. 6059. *Tranſlated from the* Latin.

THE demonſtration depends on the following *Lemmata*, *viz.*. 1. The difference of two powers of the ſame degree, divided by the difference of their roots, gives the ſeveral members of the next inferior degree of their binomial; as $\frac{y^3 - x^3}{y - x} = yy + xy + x^2$. 2. There are as many members in a binomial of any degree, as there are units in the exponent of the next ſuperior degree; *viz.* three in a ſquare, four in a cube, &c. 3. If the ſame quantity be divided by two others, whoſe ratio is given, the quotients will be reciprocally in the ſame ratio: By theſe *Lemmata* M. *Sluſius*'s method is eaſily demonſtrated, ſince they are diſpoſed in that order, which leads one, as it were by the hand, to the demonſtration.

Of the Lumbrici Lati *and* Cucurbitini; *by Dr.* Lister. Phil. Transf. N° 95. p. 6062.

IN the guts of a dog were found upwards of a hundred of the *Lumbrici Lati*, or tape-worms, the *Duodenum* was exceedingly ſtuffed with them; they were alſo found in the dog's *Jejunum* and *Ileon*, but none lower than the valve of the *Colon*, nor any higher than the *Duodenum*, or within the *Pylorus*; below the *Duodenum* they lay at certain diſtances from each other, tho' ſometimes twiſted together in pairs or more; near them their excrement was always found diſtinct both in colour, which was more grey, and conſiſtence from the chyle; theſe worms lie generally with the ſmall end upwards; expecting the deſcent of the chyle, and feeding upon it: The *Lumbrici Lati* were none of them above a foot long, and generally of an equal length and bigneſs; the one extremity was as broad as the nail of a little finger, and pointed like a lancet; the other extremity growing gradually ſmaller, for one third of the whole length of the animal was knotted, or ended in a ſmall button, like a pin's-head; they were all over milk-white, flat and thin, like fine tape, divided into infinite rings, and inciſures; each inciſure has ſharp angles on both ſides, looking towards the broader extremity, and ſtanding out beyond each other; whence Dr. *Liſter* takes the ſmall end to be the head, becauſe otherwiſe the ſharp corners of the rings would neceſſarily hinder the aſcent of the animal; whereas if the contrary be true, they ſerve to ſuſtain it: Each ring has alſo on the one ſide only, and that alternately, one ſmall protuberance, much like the middle feet of ſome caterpillars.

There is another ſort of *Lumbrici Lati* to be alſo frequently met with in dogs, called *Cucurbitini*, from the reſemblance each ring, or link has to a cucumber-ſeed; they are ſometimes found about half a foot long, but they are often broken into ſhorter pieces; the former worm is undoubtedly a compleat and entire animal; but there is great reaſon to ſuſpect, that this latter is a chain of many animals linked together: Theſe animals for kind, have been obſerved to have been voided by men, and found of a prodigious length, and encloſed in a gut or membrane; and in the kidney of a dog, which was much waſted, and become a perfect bladder, ſomething like an animal of a monſtrous ſhape was found; which being diſſected, proved only to be a membrane full of theſe *Lumbrici Cucurbitini*: It were to be wiſhed, that ſuch as have the opportu-

nity

nity of obſerving ſuch new phænomena, as ſnakes, lizards, beetles, caterpillars, toads, *&c.* recorded in medicinal hiſtories to have been voided, or found in any part of the body, would carefully examine, whether they are not theſe worms under ſuch diſguiſes.

A Way of Catching Carps; *by Mr.* J. Templer. Phil. Tranſ. N° *95*. p. *6066*.

YOU grope out the carps in the ſedge or weeds on the ſides of the pond, and tickling them with the fingers under the belly, you thruſt them into the gills, and thus throw them out on dry land: Carps, and poſſibly all other fiſh, that keep near the bottom, are always in ſhoals; when they move from one place to another, they raiſe the mud in the heat of the day, ſo that you may plainly obſerve what road they take, and that with ſo much certainty that you may eaſily cover the greateſt part of them with a caſting-net: The laire of the carps, if I may ſo call it, is diſcovered by the warmth of the water; ſo that when that heat is felt, tho' you neither ſee nor feel any carps in the middle of the ponds you may immediately repair to the ſides, and purſue your game.

An eaſy way of raiſing Fruit-trees; *by Mr.* Lewis. Phil. Tranſ. N° *95*. p. *6067*.

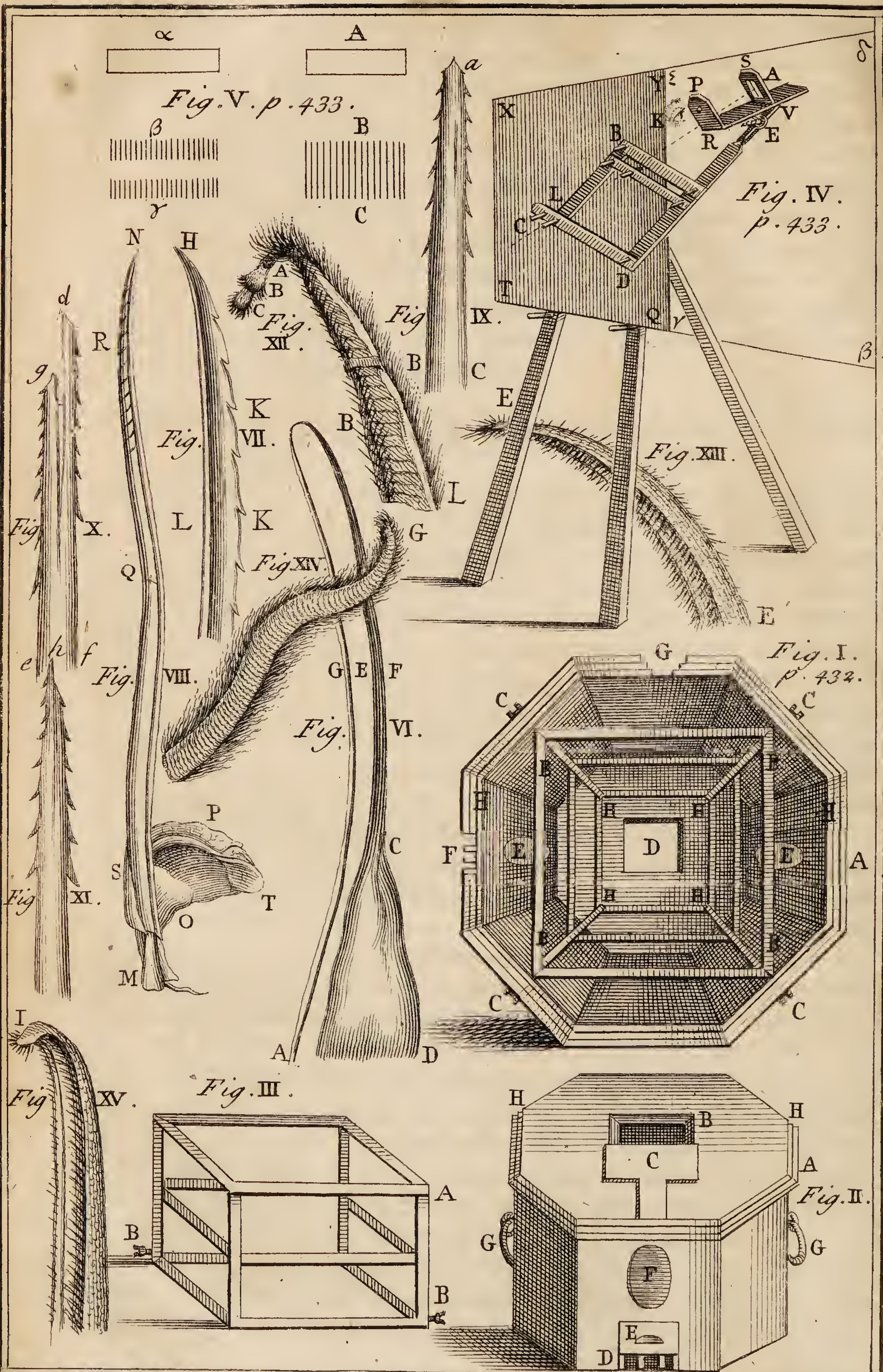
TAKE a piece of the root of any apple or pear-tree, *&c.* about ſix inches long, and tongue-graft a cyon of an apple or pear into the root; which is done thus, cut both the root and the graft a-ſlope about an inch, and that very ſmooth; then cleave them both about an inch, and inſert them into each other, that the ſap of the graft may join that of the root as much as poſſible; lap the jointed part about with a little hemp, or flax-hurds, and ſet the root ſo grafted into the ground about 10 or 12 inches deep, ſo that the joint may be covered about four inches under the earth, that it may not at any time be bared, but kept moiſt by the earth: The root you graft upon muſt not be leſs than your cyon, it is no diſadvantage that it be bigger, only then you can join the ſap of the graft and root on one ſide; but it is beſt that the root and graft be of the ſame bigneſs, for then you can join them on both ſides: It is not neceſſary your graft be one year's growth, it may be any fair ſtreight branch, as big as a man's finger, five or ſix foot long, providing the root be proportionable: The roots of young trees are to be preferred to thoſe of older trees,

becaufe they will be apter to take in fap, and nourifh the branch grafted into them: The beft roots are thofe that are rais'd from kernels, which may be drawn at one, two, or three years old, according to their growth. Mr. *Lewis* himfelf had fown a bed of apple-kernels in *March*, the enfuing fpring he pluckt up 40 of thefe feedlings, grown to the thicknefs of a fair graft, and after tongue-grafting he planted them again; they all grew, and four of them bore fruit to perfection that year; fo that in a year and a half's time from an apple-kernel he had fruit, and fuch as was larger than ordinary: And he was of opinion that plumbs, cherries, apricocks, peaches and all forts of fruit trees might be thus raifed.

A Defcription of a Bee-houfe *in* Scotland; *by Mr.* Oldenburg. Phil. Tranf. N° *96*. p. *6097*.

A, Fig. 1. Plate XII. is a bee-houfe lying on one fide with the frame BBBBBBBB placed in it; CCCC the fcrew-pins that hold the frame faft; D the fquare hole open at top; E the windows; F the door for the bees to go in and out; G the place by which the knife enters to cut the honey-combs afunder on occafion; HH the internal creafe at bottom. A Fig. 2. the bee-houfe fet upright; B the fquare hole, thro' which the bees work downwards; C the fhutter, that covers the hole on occafion; D the door for the bees; E a fliding fhutter, that covers the door in winter; F the window; G the handles for lifting; HH the external creafe at top, for faftening one bee-houfe over another. A Fig. 3. the frame for the bees to faften their work upon; BB the fcrew-nails: This bee-houfe is made of wainfcot, about 16 inches in height, and 23 in breadth between the oppofite fides; it has eight fides, each almoft nine inches in breadth; it is clofe covered a top with boards, with a fquare hole in the middle, five inches long, and about four inches broad, with a fhutter that flides too and fro in a groove about half an inch longer than the hole; it has two windows oppofite to each other; and may have more of any figure you pleafe, with panes of glafs and fhutters; the door for the bees is divided into three or four holes, about half an inch wide, and as much in height, with a fhutter that flides in a groove to cover them in winter; it has two iron handles with joints to be placed about the middle, if there be no windows on the fides, where they are, or above them; if there be, it has a creafe all round it at top, half an inch in depth on the outfide, and an inch and a half high; and another

PLATE. XII.



G. Smith del. Hulett Sculp

another on the inſide at bottom, which ſerves to fix them when ſet upon each other; it has alſo a hole about two inches in height, and as much in breadth on one ſide at bottom, by which the knife is put in to cut the combs, that paſſes thro' the hole from one bee-houſe into another, ſince they work downwards into the empty houſe, which has a ſliding ſhutter to cover it; within the bee-houſe is a ſquare frame, made of four poſts joined at top, at bottom, and in the middle, with four ſticks for the bees to faſten their work upon; which, tho' ſufficient, yet it may be proper to add two more croſſing the frame either from the middle of the oppoſite ſide-ſticks, or from angles where the poſts are placed: This manner of a bee-houſe is uſeful to prevent their ſwarming, which is done by placing an empty one thus made under the full one, with the door at top open, that they may work downwards into it; and when both are full, the bees will be in the loweſt houſe; and then to have the honey and wax without deſtroying or troubling the bees, cut the work as low as you can with a thin long knife, broad at the end, and ſharp on both ſides, and take off the uppermoſt bee-houſe by the handles, and being reverſed, the ſcrews are to be taken out, and then the frame with all the work will eaſily ſlip out, and ſo the empty bee-houſe may be immediately ſet under the other, if neceſſary; and the uppermoſt having the ſquare hole above covered with the ſhutter, ſome other cover may be ſet over it, to keep the bees from the injuries of the weather; and if this ſeparation be made in the ſpring or ſummer, the bees will like their new houſe the better becauſe it has been uſed before.

A new Way of delineating orthographically, by parallel viſual Rays, *the* Attitudes *and* Geſtures *of a* Human Body, *obſerving exactly the* Proportion *and* Symmetry *of the* Parts; *by Mr.* St. Clare. Phil. Tranſ. N° *96.* p. *6.* *Tranſlated from the* Latin.

LEt A B C D, Plate XII. Fig. 4. be a proſopographic or delineating parallelogram; H F a central ſtyle or pin; L C a drawing pen, R A an index or oblong ruler, fitted perpendicularly to the plane of the parallelogram, by means of a ſcrew-nail of braſs; in this ruler two *Dioptræ* or ſights are fixt, as P R, S U; in the middle of P R is a hole O, and in the middle of S U is a thread erected perpendicular to the ruler R A, in whoſe middle is a certain ſmall globule, thro' which, and the hole

hole O, a ray from the object reaches the eye, which in delineating muſt be free and looſe, and not fixt.

It is to be obſerved, 1. That a ray paſſing thro' the hole O and the globule, will be always perpendicular to the plane of the parallelogram, or its diameter, which is a right line paſſing thro' the pencil L C, the immoveable centre H F, and the abovementioned ſmall globule; in which line the globule always is, whatever be the motion of the parallelogram. 2. That Q Y X T is the ſenſible delineatory plane, upon which the point L of the pencil L C moves, which exactly deſcribes the image by the motion of the ruler R A; into which plane the central ſtyle H F is fixed; but that E δ B γ is the rational or mathematical plane, a continuation of the former. 3. That all rays reaching from the object thro' the globule and hole O to the eye, placed according to the direction of the ruler in as many points of the diaphanous medium, as there are points in the viſible ſurface of the object to be deſcribed, which are infinite, will be always parallel to each other; which is thus demonſtrated; lines parallel to the ſame line, tho' not in the ſame plane, are parallel among themſelves 10. *Euc.* XI. but all the rays reaching from the object thro' the ſights to the eye are parallel to the ſame right line, *viz.* to the ray paſſing from the object thro' the globule and the hole O, conſequently they are parallel to each other; for if two right lines are perpendicular to the ſame plane, theſe lines will be parallel 6. *Euc.* XI. but the primary ray reaching from the object thro' the ſights to the eye, and all the other ſecondary rays are perpendicular to the rational or mathematical plane, by the hypotheſis; therefore all the rays paſſing from the object thro' the ſights to the eye are parallel to the ſame right line, *viz.* to the ray paſſing thro' the globule and hole O. Q. E. D.

Some Conſiderations upon Mr. Newton's Doctrine *of* Colours, *and on the Effects of different Refractions in teleſcopical Glaſſes.* Phil. Tranſ. N° *96.* p. *6086.*

THE moſt important objection againſt Mr. *Newton* by way of query, ſeems to be, whether there be more than two ſorts of colours? For the remarker's part, he thinks, that an hypotheſis that ſhould explain mechanically, and by the nature of motion the colours yellow, green, and blue, would be ſufficient for all the reſt, in regard thoſe others, being only more deeply charged, as appears by the priſms of Dr. *Hook,* to pro-

duce

duce the dark, or deep red and blue; and that of theſe four all the other colours may be compounded; nor does he ſee why Mr. *Newton* does not content himſelf with the two colours, yellow and blue; for it will be much more eaſy to find any hypotheſis by motion, that may explain theſe two differences, than for ſo many diverſities, as there are of other colours; and till he has found this hypotheſis, he has not taught us, what it is wherein the nature and difference of colours do conſiſt, but only this accident, which certainly is very conſiderable, of their different refrangibility. As for the compoſition of white made up of all the colours together, it may poſſibly be, that yellow and blue might alſo be ſufficient for that, which is worth while to try; and it may be done by the experiment, which Mr. *Newton* propoſes, by receiving againſt a wall of a darkened room the colours of the priſm, and caſting their reflected light upon white paper; here you muſt hinder the colours of the extremities, *viz.* the red and purple, from ſtriking againſt the wall, and leave only the intermediate colours, yellow, green, and blue; to ſee, whether the light of theſe alone would not make the paper appear white, as well as when they all yield light; and the remarker even doubts, whether the lighteſt place of the yellow colour may not alone produce that effect; and if that be the caſe, it can no more be ſaid, that all the colours are neceſſary to compound white; and it is very probable, that all the reſt are nothing but degrees of yellow and blue, more or leſs charged.

As to the effects of the different refractions of the rays in teleſcopical glaſſes, it is certain, that experience is againſt Mr. *Newton*; for to conſider only a picture, which is made by an object-glaſs of 12 foot in a dark room, we obſerve it too diſtinct and too well defined to be produced by rays, that ſhould ſtray the 50th part of the aperture; ſo that the difference of the refrangibility does not poſſibly always follow the ſame proportion in the great and ſmall inclinations of the rays upon the ſurface of the glaſs.

Mr. Newton's *Anſwer to the preceeding Obſervations, with a further Explication of his* Theory *of* Light *and* Colours, *&c.* Phil. Tranſ. N° 96. p. 6087.

THO' white could be produced from two uncompounded colours, yet nothing could be concluded thence, becauſe it would have different properties from the white of the ſun's immediate light, which would evince it to be of a different conſti-

conſtitution; inſomuch that ſuch a production of white would be ſo far from contradicting, that it would illuſtrate and confirm Mr. *Newton*'s theory; becauſe by its difference from other white colours it would appear, that other white colours are not compounded of two only colours like that; and therefore in order to prove any thing, it is requiſite that he not only produce out of two primitive colours a white, which to the naked eye ſhall appear like other white colours, but ſhall alſo agree with them in all other properties: But Mr. *Newton*, in order to ſhew wherein ſuch a white would differ from other white colours, and why from thence it would follow that other white colours are otherwiſe compounded, lays down the following propoſition; viz. *that a compounded colour can be reſolved into no more ſimple colours than thoſe of which it is compounded*; this ſeems to be ſelf-evident: Let *a*, Plate XII. Fig. 5. repreſent an oblong piece of white paper, about $\frac{1}{2}$ or $\frac{1}{4}$ of an inch broad, and illuminated in a dark room with a mixture of two colours, thrown upon it from two priſms, ſuppoſe a deep blue and ſcarlet, which muſt ſeverally be as uncompounded as they can conveniently be made; then at a convenient diſtance, ſuppoſe of ſix or eight yards, view it thro' a clear triangular glaſs or cryſtal priſm, held parallel to the paper, and you ſhall ſee the two colours ſeparated from each other in form of two images of the paper, as they are repreſented at β and γ, where ſuppoſe β the ſcarlet and γ the blue, without green or any other colour between them: Now from the aforeſaid poſition he deduces theſe two concluſions; 1. If there were found out a way of compounding white of two ſimple colours only, that white would be again reſolvable into no more than two. 2. That if other white colours, as that of the ſun's light, &c. be reſolvable into more than two ſimple colours, as by experiment is found they are, then they muſt be compounded of more than two: To make this plainer, ſuppoſe that A repreſents a white body illuminated by a direct beam of the ſun, tranſmitted thro' a ſmall hole into a dark room, and α ſuch another body illuminated by a mixture of two ſimple colours, which if poſſible may make it alſo appear of a white colour, exactly like A; then at a convenient diſtance view theſe two white colours thro' a priſm, and A will be changed into a ſeries of all colours, red, yellow, green, blue, purple, with their intermediate degrees ſucceeding in order from B to C; but α, according to the preceeding experiment, will only yield theſe two colours of which it was compounded, and theſe not defined like the

the colours at B C, but ſeparate from each other, as at β and γ, by means of the different refrangibility of the rays to which they belong; and thus by comparing theſe two white colours, they would appear to be of a different conſtitution, and A to conſiſt of more colours than α.

Mr. *Newton* proceeds thus to a further explication of his theory,

Definition 1. He calls that light homogeneal, ſimilar, or uniform, whoſe rays are equally refrangible.

2. And that light heterogeneal, whoſe rays are unequally refrangible.

N. B. There are but three affections of light, in which he obſerved its rays to differ, *viz.* refrangibility, reflexibility, and colour; and ſuch rays as agree in refrangibility agree alſo in the other two, and therefore may well be defined homogeneal, eſpecially ſince men uſually call thoſe things homogeneal, which are ſo in all qualities that come under their knowledge, tho' in other qualities to which their knowledge does not extend, there may poſſibly be ſome heterogeneity.

3. Such colours he calls ſimple or homogeneal, which are exhibited by homogeneal light.

4. And thoſe compounded or heterogeneal, which are exhibited by heterogeneal light.

5. He denominates different colours, not only the more eminent ſpecies, red, yellow, green, blue, purple, but all other the minuteſt gradations; much after the ſame manner, that not only the more eminent degrees in muſick, but all the leaſt gradations are eſteemed different ſounds.

Propoſition 1. The ſun's light conſiſts of rays differing by indefinite degrees of refrangibility.

2. Rays differing in refrangibility when ſeparated from each other, do proportionably differ in the colours they exhibit; theſe two propoſitions are matter of fact.

3. There are as many ſimple or homogeneal colours, as degrees of refrangibility; for to every degree of refrangibility belongs a different colour, by *Prop.* 2. and that colour is ſimple by *Def.* 1. and 3.

4. Whiteneſs in all reſpects like that of the ſun's immediate light, and of all the uſual objects of our ſenſes cannot be compounded of two ſimple colours alone; for ſuch a compoſition muſt be made by rays that have only two degrees of refrangibility by *Def.* 1. and 3. and therefore it cannot be like that of

the ſun's light, by *Prop.* 1. nor for the ſame reaſon, like that of ordinary white objects.

5. Whiteneſs in all reſpects like that of the ſun's immediate light cannot be compounded of ſimple colours without an indefinite variety of them; for to ſuch a compoſition are requiſite rays indued with all the indefinite degrees of refrangibility, by *Prop.* 1. And theſe infer as many ſimple colours, by *Def.* 1. and 3. and *Prop.* 2. and 3.

6. The rays of light do not act on each other in paſſing thro' the ſame medium.

7. The rays of light ſuffer not any change of their qualities from refraction.

8. Nor afterwards from the adjacent quiet medium; theſe two propoſitions are manifeſt in homogeneal light, whoſe colour and refrangibility are not at all changeable, either by refraction, or by the contermination of a quiet medium; and as for heterogeneal light, it is but an aggregate of ſeveral ſorts of homogeneal light; none of which ſuffers any more alteration than if it were alone, becauſe the rays act not on each other by *Prop.* 6. and therefore the aggregate can ſuffer none.

9. There can no homogeneal colours be educed out of light by refraction, which were not commixt in it before; becauſe by *Prop.* 7. and 8. refraction changes not the qualities of the rays, but only ſeparates thoſe which have different qualities, by means of the different refrangibility.

10. The ſun's light is an aggregate of an indefinite variety of homogeneal colours, by *Prop.* 1, 3, and 9; and hence it is, that he calls homogeneal colours alſo primitive or original.

Of the Number of Colours, *and the Neceſſity of mixing them all for the Production of* White; *and why a* Picture *thrown by Glaſſes into a darkened Room appears ſo diſtinct, notwithſtanding the irregular Refractions; by Mr.* Newton. Phil. Tranſ. N° 97. p. 6108.

ALL colours cannot be derived from yellow and blue, or none of thoſe defined original colours, as the animadverter would have it; nor is it eaſier to frame an hypotheſis by aſſuming only two original colours, rather than an indefinite variety; unleſs it be eaſier to ſuppoſe, that there are but two figures, ſizes, and degrees of velocity or force of the ætherial corpuſcles or pulſes, rather than an indefinite variety; which certainly would be a harſh ſuppoſition: But Mr. *Newton* never intend-

intended to ſhew wherein the nature and difference of colours conſiſted, but only that in fact they are original and immutable qualities of rays, which exhibit them; but he would not have it underſtood as if their difference conſiſted in the different refrangibility of theſe rays; for that different refrangibility conduces to their production no otherwiſe, than by ſeparating the rays whoſe qualities they are; whence it is, that the ſame rays exhibit the ſame colours, when ſeparated by any other means, as by their different reflexibility.

The mixture of yellow, green and blue, without red and violet, which the animadverter propoſes for producing white, will produce green inſtead of white; and the brighteſt part of the yellow will afford no other colour but yellow; if the experiment be made in a room well darkened as it ought to be; becauſe the coloured light is much weakened by the reflexion, and ſo apt to be diluted by the mixture of any other ſcattering light; but yet there is an experiment by which white is produced out of two colours alone, by throwing the colours of one priſm upon thoſe of another; yet nothing can be deduced from thence, for the two colours are compounded of all the other colours; *e. gr.* orange and a full blue produce a white; but the orange is compounded of red, orange, yellow, and ſome green; and the blue, of violet, full blue, light blue, and ſome green, with all their intermediate degrees, and conſequently the orange and blue together make an aggregate of all the colours to conſtitute white.

As to the diſtinctneſs of a picture thrown by a 12 foot object glaſs into a darkened room, Mr. *Newton* declared his ſurpriſe, that conſidering the irregularity of refractions, teleſcopes could be brought to ſo great perfection as they are; but to remove this difficulty, tho' in the firſt place he put the greateſt lateral error of the rays from each other to be about $\frac{1}{50}$ of the diameter of the glaſs, yet their greateſt error from the points on which they ought to fall, will be but $\frac{1}{100}$ of that diameter; and ſecondly, that the rays, whoſe error is ſo great, are but very few in compariſon of thoſe, which are refracted more juſtly; for the rays which fall on the middle parts of the glaſs, are refracted with ſufficient exactneſs, as alſo thoſe that fall near the perimeter, and have a mean degree of refrangibility; ſo that there remain only the rays which fall near the perimeter, and which are more or leſs refrangible, to cauſe any ſenſible confuſion in the picture; and theſe are yet ſo much further weakened by the greater ſpace thro' which they are ſcattered,

that the light, which falls on the due point, is infinitely denſer than that which falls on any other point round about it; and by this exceſs of denſity, the light which falls in or near the juſt point, may, he thinks, ſtrike the *Senſorium* ſo vigorouſly, that the impreſs of the weak light ſcattered round about it, ſhall comparatively not be ſtrong enough to be obſerved, or to cauſe any greater confuſion in the picture than is found by experience.

Ambergreaſe, *a Vegetable Production.* Phil. Tranſ. N° 97. p. 6115.

AMbergreaſe is not the ſcum or excrement of the whale, *&c.* but iſſues out of the root of a tree; which, at what diſtance ſoever it grows on the land, always ſhoots forth its roots towards the ſea; wherever that fat gum is diſcharged into the ſea, it is ſo tough, that it is not eaſily broken from the root, unleſs its weight or the toſſing of the ſea ſeparate it, and ſo make it float on the ſurface: If you plant the trees where the ſtream ſets to the ſhore, then the ſtream will caſt it up to great advantage.

Microſcopical *Obſervations*; *by M.* Leewenhoeck. Phil. Tranſ. N° 97. p. 6116.

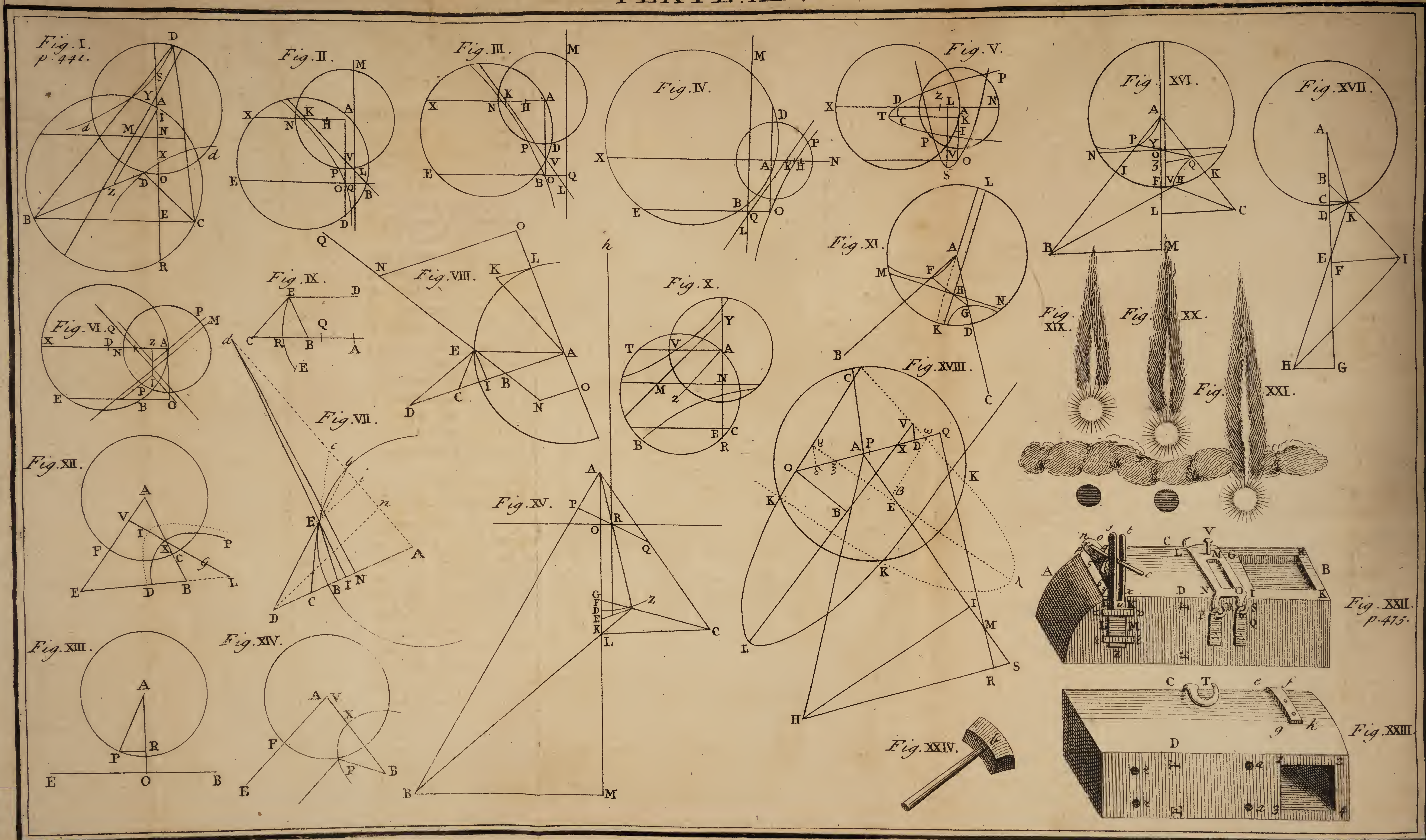
AB. Fig. 6. Plate XII. is the great ſting, or rather ſheath, or caſe, out of which the two ſtings were taken; E is the cavity of the ſheath, in which they lie; D is the thickneſs of the caſe below; and about D A the two ſtings ſhew themſelves, each in a ſeparate place.

H I Fig. 7. is part of the ſting taken out of the ſheath, A B, which appears a little laterally; whence it is, that the beards K K do not appear ſo big or ſo ſharp, as in reality they are; L is the back of the ſting without beards.

M N Fig. 8. is the whole ſting, taken out of the ſheath, and with its back, which is without beards turned to the eye; the upper part of the ſting N Q is encloſed round about, and is hollow within, and the lower part Q S is open; S M is a part of the broken nerve, very near as long as the whole ſting; and when it can be taken whole out of the body, it contracts itſelf into the ſhape of a half-moon, and appears of the colour of a tortoiſe-ſhell, as the ſting itſelf does; O P is the body faſtened to the ſting, and placed in the thicker part of the caſe D C A, in Fig. 6.

A B C Fig. 9. are both the ſtings, as they lie together before, cloſe againſt the ſheath; yet one of them is a little higher than the other.

PLATE. XIII.



G. Smith del. Hulett Sculp

edgfh Fig. 10, are both the ſtings, in part out of the ſheath; yet the ſting *edh* ſtands a little higher out of the caſe than the other *gfh*; thus they are found to lie in the ſheath when at reſt.

Fig. 11. Two ſtings ſtanding alſo a little out of the ſheath; as to their motion, it may be conceived to be thus made; firſt, the bee exerts her ſheath, together with its ſting, and endeavours to thruſt it together with one of the ſtings, as far as ſhe can into the body ſhe would wound; but not being able to return it again on account of its beards, ſhe then alſo thruſts the other ſting into the body as deep as ſhe can, and endeavours to pull that back, upon which ſhe thruſts her ſheath and firſt ſting yet deeper into the body; and this ſhe continues till ſhe get both the ſtings and the ſheath, as far as to the thick part of the latter into the body; after which, the ſtings require no more motion out of the ſheaths.

Fig. 12. L D A B C is one of the arms of the bee, wherewith, M. *Leewenhoeck* thinks, ſhe makes her honey-combs, furniſhed with three peculiar joints, as at D, A, B.

E F, Fig. 13. Is one of the ſcrapers, placed on the forepart of her head, by which ſhe ſcrapes the wax from flowers.

Fig. 14. G H called the wiper, is placed forward on her head, and with it ſhe wipes the honey off the flowers.

Fig. 15. K I repreſents the ſcraper of a wild-bee.

A Problem of Alhazen *ſolved; by M.* Huygens *and M.* Sluſius. Phil. Tranſ. N° 97. p. 6119.. *Tranſlated from the* Latin.

M. *Huygens* propoſes the problem thus; a concave or convex ſpeculum being given, as alſo the eye and the viſible point to find the point of reflexion: Let the ſpherical ſpeculum have the point A for its centre, Fig. 1. Plate XIII. let the eye be in B, and the viſible point in C, and let a plane drawn thro' A, B, C cut in the ſphere the circle D*d*, in which the points of reflexion may be found; let a circle be deſcribed thro' the three points A, B, C, and let its centre be Z; let A E, a perpendicular to B C, be produced and meet it in R; and let N A be a third proportional to R A and O A, and N M a parallel to B C will be one of the aſſymptotes; again let E A, $\frac{1}{2}$ O A, and A I be proportional, and aſſuming I Y equal to I N, let Y M be drawn parallel to A Z, and that will be the other aſſymptote; in fine aſſuming I X, and I S, each of which may in power be equal to half the ſquare of A O together with the ſquare of A I, the points X and S will be

be in the hyperbola, or in the oppoſite ſections D*d*, D*d*, which are to be drawn to the aſſymptotes found, whoſe interſections with the circumference D O will ſhew the points of reflexion ſought: This conſtruction holds in every caſe, wherein the problem is ſolid, excepting one, where a parabola and not an hyperbola is to be deſcribed, *viz.* when the circumference, drawn thro' the points A, B, C, touches the right line A E.

M. *Sluſius* takes the problem, when expreſſed in terms purely geometrical, to be only this; in a given circle, whoſe centre is A, and radius A P Fig. 2, 3, 4, to find ſome point as P, from which drawing the right lines P E, P B to the given points E, B, unequally diſtant from the centre A, the right line A P produced may biſect the angle E P B; which admits of various caſes; for either the perpendicular from A upon the right line E B, *viz.* A O, falls between E and B, or beyond B; if beyond it, either the rectangle E O B is equal to the ſquare of A O, or greater or leſs; he afterwards treats of the caſe of equality, and here he comprehends the other caſes almoſt in the ſame conſtruction; let a circle paſs thro' the three points A, E, B, to whoſe circumference let A O be produced to D; and if the point O fall between E and B, the right line A O muſt be produced towards O; but if beyond B, and the rectangle E O B be greater than the ſquare of A O, it muſt be produced towards A; but if the rectangle be leſs than that ſquare, the circle will cut the right line A O in the very point D; then drawing A X parallel to E B, cutting the given circle in N, let it be as the rectangle D A O to the ſquare of A N, ſo $\frac{1}{2}$ A X to A H, which muſt be taken towards X, if O fall between E and B, or if the rectangle E O B be leſs than the ſquare of O A, but on the contrary ſide, if it be greater; now let O Q be made equal to A H, in the third caſe to be taken towards E, but in the firſt and ſecond caſes the contrary way, then let X A, N A, and H K be proportional, to be taken in every caſe towards X, and cutting A O in U, that K A may have the ſame ratio to A U, as A D to A X; join K U, and let it be produced till the right line E M meet the parallel O A indefinitely produced, in the point L; in every caſe K L and Q L will be the aſſymptotes of the hyperbola, which drawn thro' the point O will ſatisfy the queſtion; with this only difference, that in the firſt and ſecond caſes, the hyperbola paſſing thro' O will ſolve the problem in a convex *Speculum*, and the oppoſite ſection in a concave one; but on the contrary in the third caſe, the hyperbola thro' O will ſerve for the concave, and

and its oppoſite for the convex, and that when the point U falls between A and O; for if it ſhould fall beyond O, one only hyperbola drawn between the ſame lines K L, and Q L would ſerve for both the convex and concave *Specula*; beſides if U ſhould fall upon the point O itſelf, then it would be a plane problem, and the right lines L Q, L K would reſolve it; whence it appears that this problem admits of infinite caſes, which may be reſolved by a plane *Locus*; whence thoſe are more excuſable who thought it might be univerſally ſolved by the ſame *Locus*, becauſe ſometimes the calculation had ſucceeded happily with them; for there can be given no poſition of the three points A, E, B, (of the caſe of the equality of the rectangle E O B, and the ſquare O A we ſhall ſee more anon) which may not admit of ſome circle to be deſcribed from the centre A, at whoſe circumference the problem may be ſolved by a plain *Locus*; the *Radius* of this circle will be thus found; in the firſt and ſecond caſe of the above conſtruction; let it be as the ſquare of A X, together with twice the rectangle O A D, to double the ſquare of A D; ſo the ſquare of A O to the ſquare of A N, A N will be the *Radius* ſought; but in the third caſe, it muſt be, as the ſquare of A X *minus*, twice the rectangle O A D, to the double ſquare of A D; ſo the ſquare of A O to the ſquare of A N. The other caſe now remains to be conſtructed, *viz.* that of the equality of the rectangle of EOB, and the ſquare of A O, or that in which the circle drawn thro' the points A, B, E, touches the right line A O; for M. *Huygens* has well obſerved, that a parabola is to be deſcribed in that caſe; which yet is not to be ſo underſtood, as if it could not be ſolved by an hyperbola, ſeeing it may admit both of an hyperbola and an ellipſis, even to infinity, if any would uſe M. *Sluſius*'s method; only this caſe admits the parabola, which other caſes do not, and we are to make the ſame limitation when he ſays, that his conſtruction takes place in every caſe wherein it is a ſolid problem; for his meaning is, that by a ſmall alteration an hyperbola may always be found that will ſatisfy the queſtion; which will be plain to any one that ſhall compare the caſes above by M. *Sluſius* conſtructed with M. *Huygen*'s conſtruction: But to return to the caſe of equality, here are not one but two parabola's, and beſides oppoſite hyperbola's which reſolve the queſtion: Let as before, the given points be E, B, Fig. 5. a circle from the centre A, and another thro' the three points A, E, B, whoſe tangent let A O be, and centre D; having drawn the diameter N A D X, let X A, N A,

N A, Z A be three proportionals, and let A L be the half of Z A; let there be again three proportionals 2 O A, N A, I A, whose half let K A be, and let the rectangle L A O U be compleated, and producing L U to S, till U S be a third proportional to A I, O U; let a parabola be described with the axis S L, the parameter A I, and from the vertex S, it shall cut the circle in the points P P sought; the same thing will be done by another parabola, if, after compleating the rectangle D A K C, and producing K C to T, in such a manner, that C T be a third proportional to A Z and D C, it be described about the axis T K, with the *Latus Rectum* Z A, and from the vertex T; for it will meet the circle in the same points P P. But the construction by the opposite sections is still more easy; for making, as before, X A, N A, and Z A, Fig. 6. three proportionals, let the perpendicular Z I be let fall, a third proportional to the double of A O and A N; Z I will therefore be greater than Z A, since its double A O is less than X A; then in the point I, let the right lines I Q and I M be on both sides inclined in a half right angle to the line I Z, and let them be produced indefinitely both ways; and in fine, let an hyperbola be described about them as so many assymptotes thro' the point A, and another opposite thereto; the latter will satisfy the problem in a convex *Speculum*, and the former in a concave one; for since, as was demonstrated, Z I is always greater than Z A, the right line I M will never pass thro' A; therefore a case will not be given wherein from this construction, as in thepreceeding, the problem may be resolved by the assymptotes themselves; and yet this sometimes also admits of a plain *Locus*, *viz.* when it happens that the right line X O drawn to the centre D, touches the circle N P P; for the point of contact itself solves the problem.

The same problem is otherwise solved by M. *Slusius* thus; let there be given a circle, whose centre is A, and let the given points be D and d, Fig. 7. let what is sought be supposed done; and let D E be the incident ray, E d the reflected, and from the point of reflection E let fall on D A the perpendicular E I, and from d upon the same line the perpendicular d N, and let the tangent E C, and the ray d E produced to B meet the same line: Suppose now D A $= z$, A I $= a$, N A $= n$, E I $= e$, dN $= b$, B A $= y$, A E $= q$, C A $= x$; therefore, since the angles D E C, and C E B are equal, and the angle C E A a right angle by the supposition, the three lines D A, C A, B A will be harmonically proportional; therefore it will be as D A to B A, so D C to C B, or in algebraic terms, $z : y :: z - x :$

$x - y$

$x - y$; and $2zy - xy = zx$, or $\frac{2zy}{z + y} = x$; for feeing the rectangle C A I, or xa, is equal to the fquare of A E, or qq, it will be $x = \frac{qq}{a}$, and confequently, $\frac{2zy}{z + y} = \frac{qq}{a}$, or $\frac{zqq}{2za - qq} = y$: Moreover it is as d N to E I, fo is N B to I B; or $b : e :: y - n : y - a$, therefore $ye - ne = by - ba$, and $y = \frac{ba - ne}{b - e}$, confequently $\frac{zqq}{2za - qq} = \frac{ba - ne}{b - e}$, or, $2zbaa - 2zane - qqba + qqne = bzqq - zqqe$, which is the equation to the hyperbola about its affymptotes, whofe conftruction, together with the given circle, anfwers the problem; for fince, on account of the circle, it is $qq = aa + ee$, if inftead of $2bzaa$ be fubftituted its value $2bzqq - 2bzee$, another equation will alfo be had to the hyperbola about its affymptotes, *viz.* $bzqq - 2bzee - 2znae - qqba + qqne = - zqqe$; and by this method, and that other M. *Slufius* explained in his book on *Analyfis*, infinite equations to hyperbola's and ellipfes will arife, which with the given circle will refolve the problem; only the effections will generally be more intricate; but they may be conftructed by that method ufed in the ellipfis, *p.* 62, of the fame book.

The whole of the calculation, as may be feen, is referred to the line D A, and it could be as eafily referred to d A, which is likewife given, *viz.* after firft drawing the prickt lines in the fcheme; but there is no occafion for a new calculation; for if you ufe the fame fymbols as before, for the right line d A and its parts, that is, if you make d A $= z$, D$n = b$, n A $= n$, A I $= a$, i E $= e$, &c. the fame equation will arife as before, and you will have infinite other hyperbola's and ellipfes, which, with the given circle, will fatisfy the problem; it would be tedious to profecute the feveral cafes, fince their equations may be diftinguifhed by only changing the figns $+$ and $-$; only one cafe is excepted, *viz.* when d A B is a right angle, for its equation is obtained, after expunging all the terms out of the former equation, wherein n, which becomes nothing, is found; *viz.* this equation, $2zbaa - qqba = bzqq - zqqe$, or, fubftituting for $2zbaa$ its value, $zbqq - qqba = 2zbee - zqqe$.

But it is to be obferved, that tho' by referring the *Analyfis* to the right line D A, there immediately offer two hyperbola's in the equation; and as many more different from the former,

when it is referred to the right line d A; yet that the very same parabola's are obtain'd, to which soever of the lines d A or D A the *Analysis* be referred, will easily appear.

Now to apply the former *Analysis* to all problems relating to the reflexion of spherical *Specula*; let there be, as before, a circle, whose centre is A, Fig. 8, a given point D, and from it the incident ray D E, whose reflected ray let be E Q; joining D A, let the tangent E C be drawn to it, and the perpendicular E I; and let the right line Q E B be produced to the same; let D A $= z$, C A $= x$, A E $= q$, B A $= y$, A I $= a$, I E $= e$; therefore, because D A, C A, B A are harmonically proportional, and the three lines C A, A E, A I, are geometrically so; you will always have the equation $y = \frac{zqq}{2za - qq}$, on whatever point of the circle the ray D E fall; therefore, if the point E be sought, on which if the ray D E fall, it may be reflected parallel to the diameter L A U, a perpendicular to D A; the reflected ray Q E produced will pass thro' I, as is plain, and I and B will coincide; therefore $a = y = \frac{zqq}{2za - qq}$, or, $aa - \frac{1}{2}\frac{qqa}{z} = \frac{1}{2}qq$, and it will be a plane problem.

If a point be sought, from which a ray may be reflected parallel to any other line, as A K drawn from the centre A; let the tangent K L $= d$ be drawn to it from the point I; it is plain, that the triangles A K L, E I B will be similar, since all the sides of the one are parallel to all those of the other, &c. therefore A L is to L K, as E I to I B, or, $q : d :: e : a - y$, and $\frac{qa - de}{q} = y = \frac{zqq}{2za - qq}$; and $zq^3 = 2qzaa - 2zdae - q^3a + qqde$; or, putting $qq - ee$ for aa, $zq^3 = 2zq^3 - 2zqee - 2zdae - q^3a + qqde$; for both the equations are for the hyperbola about its assymptotes, which with the given circle resolves the problem.

Let it now be proposed to make the reflected ray pass thro' the given point N (as in the problem of *Alhazen*) or produced towards the point of reflection E to meet the given point N; let the perpendicular N O $= n$ fall from N upon A L, and let it be A O $= b$; it is plain, that as A O is to the difference of O N and A B; so is E I to I B, that is, $b : n - y :: e : a - y$, or, $b : y - n :: e : y - a$; therefore $\frac{ba - ne}{b - e} = y =$

zqq

$\frac{zqq}{2za - qq}$; whence, $2zbaa - 2znae - qqba + qqne = bzqq - zqqe$, *viz.* that very equation of the problem of *Alhazen*, which we hinted above: Or, in the second case, $\frac{ba - re}{b + e} = y = \frac{zqq}{2za - qq}$, or, $2zbaa + 2znae - qqba - qqne = zbqq + zqqe$.

And these are the problems, that are wont to be proposed about the point of reflexion, wherein, notwithstanding the distance of the given point D is supposed to be finite; but the analysis will be easier, if we suppose it infinite; for bissecting C A in G, it appears from the property of three harmonical proportionals, D A, C A, B A, that the three lines D G, C G, B G will be geometrically proportional, supposing any distance whatsoever of the point D; therefore, if it be supposed infinite, B G will become nothing, and the point B will coincide with the point G; consequently A B will be always equal to B C, and C A $= 2y$; and the rectangle C A I equal to the square of A E will in symbols give $2ay = qq$, or $y = \frac{qq}{2a}$; and since the distance of the point D is supposed infinite, E D will be parallel to A C; therefore, if the reflected ray parallel to A L be sought, because in that case a and y do coincide, it will be $a = y = \frac{qq}{2a}$, or $aa = \frac{1}{2}qq$; if it be required to be parallel to AK, it will be again, as $q : d :: e : a - y$, and $\frac{qa - de}{q} = y = \frac{qq}{2a}$, or $2qaa - 2dae = q^3$; if it be required to pass thro' N, it will be, as above, $\frac{ba + re}{b + e} = y = \frac{qq}{2a}$, and $2baa + 2nae = bqq + qqe$, which equations are also for the hyperbola's about their assymptotes, unless the point N be supposed to be in A L; for, in that case n becoming nothing, expunge out of the equation the terms, wherein n is found, the remaining will give the equation for the parabola, as was observed above.

The same *Analysis*, and the same equations by only changing the signs may be applied to convex *Specula*; and the same parabola and ellipsis that solves the problem in the one case,

 will

will alſo do it in the other; and if the hyperbola reſolve the problem in a convex *Speculum*, the oppoſite hyperbola will do the like in a concave; by the ſame *Analyſis* in concave *Specula* may be obtained the *Foci*, and the ſpaces, which the rays poſſeſs in the axis, the diſtance of the radiant point being given; but very eaſily, when the rays are ſuppoſed parallel: For in the concave *Speculum* E E, Fig. 9. whoſe centre is A, if the extreme ray be ſuppoſed to be reflected to the axis A R in B, drawing the tangent E C, it will be C B = B A; let the ſemi-axis A R be biſſected in Q; Q will therefore be the *Focus*, and Q B the ſpace ſought; but Q B is the half of C R, becauſe of the equal lines A Q, Q R, and A B, B C, that is, half the exceſs of the ſecant of the arch E R above the whole ſine; therefore, if the arch E R be, *e. g.* 9°, A C will be 101246, and B Q $\frac{623}{100000}$ of A R.

Extraordinary Tides *about the* Orkneys; *by Sir* Rob. Moray. Phil. Tranſ. N° 98. p. 6139.

IN *Fairay-Sound*, between the iſles of *Fairay* and *Ætha* in the *Orkneys*, the ſea runs north-eaſt for the ſpace of 3 hours only in flowing, and nine hours ſouth-weſt in ebbing; this is the courſe of the tide only in the middle of the ſound, which is but one mile broad.

While the ſea runs from weſt to eaſt in flowing thro' the *Weſtra-frith*, which is eight miles in breadth, the ſurges are not greater than in any other part of the ſea; and in a calm day it is as ſmooth as any lake, tho' there is conſtantly a great current upon the flux and reflux of the ſea: Yet at the ſouth-eaſt end of a little iſland on the ſouth-eaſt ſide of *Weſtra*, and about a mile from it, the ſea no ſooner begins to run weſtward in ebbing, but a ſurge begins to appear, which continually increaſes, until the ebb be half ſpent, and afterwards it decreaſes, until it be low water, at which time no ſuch thing appears; to the eaſt and weſt of this great ſurge, there are ſome few leſſer ſurges ſeen, which are gradually leſs towards the eaſt and weſt of this great ſurge; ſo that when one begins to paſs over the eaſtmoſt ſurges, and to aſcend the largeſt, tho' the declination and altitude of the ſun be conſiderable, yet the ſurge is ſo high, as to intercept the ſight of the ſun, and ſome degrees of the firmament above it; this ſurge is about $\frac{1}{4}$ of a mile in length: When there is any wind, which breaks the tops

tops of the ſurges, there is no paſſing that way: The current of the tide is ſo ſtrong there, that there is no need either of ſails or oars.

The Problem of Alhazen *otherwiſe ſolved; by* M. Huygens. Phil. Tranſ. N° 98. p. 6140. *Tranſlated from the* Latin.

THE compendium, which M. *Huygens* found out for his firſt conſtruction, is as follows; drawing A T Fig. 10. Plate XIII. parallel to C B, and biſſecting it in U, that is the point thro' which one of the oppoſite hyperbola's ſhould paſs, whoſe aſſymptotes have been found to be Y M, M N.

But that conſtruction, which obtains in all caſes, is this; let E D Fig. 11. be the given circle, whoſe centre is A, and the given points be B and C; drawing the lines A B, A C, let B A the radius of the circle and F A be proportional; alſo C A the radius of the circle and G A; then join F G, and let it be biſſected in H; and thro' this point draw the lines L H K, M H N interſecting each other at right angles, of which let L H K be parallel to that, which biſſects the angle B A C; theſe are the two aſſymptotes of the hyperbola's to be drawn thro' the points F and G, one of which will alſo paſs thro' the centre A; their interſections, with the periphery of the circle, will determine the points of reflexion ſought.

M. *Sluſius* conſiders this problem further; he obſerves that M. *Huygens* was aware that the equilateral hyperbola could be extended to all caſes, as M. *Sluſius* had hinted above in the caſe of a right angle; as alſo that one ellipſis of an eaſy conſtruction might be ſelected from an infinite number: It remains to be obſerved, that ſince the ſections, which, together with the given circle, are applied for the ſolution of the problem interſect it in four points, two of which only ſerve for flexion; it may be aſked, what problem the two other points will reſolve; and after what manner a propoſition may be expreſſed that ſhall comprehend theſe four caſes; and whether theſe four caſes occur, when the given points are equally diſtant from the centre?

M. *Huygens* employs no other analyſis than that of M. *Sluſius*, which admits of a parabola only in one caſe; as appears from M. *Sluſius*'s two equations for the hyperbola about its aſſymptotes, *viz.*

$$2zbaa - 2znae - qqba + qqne = bzqq - zqqe,$$

And $bzqq - 2znae - qqba + qqne = 2zbee - zqqe;$

And he ſubjoined, that by a little variation, *viz.* ſubſtituting for

for qq its value $aa + ee$, infinite hyperbola's and ellipſes might be found, which, together with the given circle, might ſolve the problem; now in the former of theſe equations ſubſtituting for $bzqq$ its value, it will be $zbaa - 2znae - qqba + qqne = bzee - zqqe$: Or, $aa - \frac{qqa}{z} = ee - \frac{qqe}{b} + \frac{2nae}{b} - \frac{qqne}{zb}$; and this is M. *Huygen*'s equation.

Nothing can be more compendious than the following conſtruction of M. *Sluſius*; let the points E and B Fig. 12 be given, and a circle whoſe centre is A; joining the lines E A, B A, cutting the circle in F and C; let E A, F A, U A, be three proportionals, and again three others, B A, C A, X A; then joining U X, and producing it at pleaſure; from the vertex X, with the *Latus Tranſverſum* U X, and the *Rectum* equal thereto, deſcribe the hyperbola X P, whoſe ordinates let be parallel to the right line A B, to the diameter UXG; and it anſwers the queſtion in the caſe of a convex *Speculum*, as its oppoſite does in that of a concave one: The aſſymptotes are eaſily found; producing U X till it meet with E B, alſo produced in L; and then biſſecting U X in I, and taking L D equal to L I; D I joined will be one of the aſſymptotes on which the other falls perpendicularly at the point I; and this conſtruction M. *Sluſius* deduced from his former analyſis thus; the ſame things being given as before, let A O Fig. 13. fall perpendicularly upon E B, and let P be the point ſought, from which let fall the perpendicular P R on A O; if A O be b; E O, z; O B, d; A P, q; P R, e; A R, a; the following equation is eaſily obtained $\frac{2zdae + 2bbae - 2bqqe}{zb - bd} + ee = aa - \frac{qqa}{b}$ which may be changed into theſe, $\frac{zdae + bbae - bqqe}{zb - bd} = aa - \frac{1}{2}qq - \frac{\frac{1}{2}qqa}{b}$; and $\frac{zdae + bbae - bqqe}{zb - bd} + ee = \frac{1}{2}qq - \frac{\frac{1}{2}qqa}{b}$; M. *Huygens* had already communicated the conſtruction of the firſt equation, and M. *Sluſius* the conſtruction of this laſt, and he had almoſt neglected the firſt, tho' it eaſily offered itſelf, becauſe he preſumed it to be of more difficult conſtruction; but he was undeceived after he lighted on this laſt conſtruction; let it be for brevity ſake, $z - d = k$, $zd + bb = bm$, and it will be $\frac{2mae - 2qqe}{k} + ee = aa - \frac{qqa}{b}$, and adding

to

to both sides $\frac{q^4 + mmaa - 2qqma,}{kk}$ it will be $\frac{2mae - 2qqe}{k} + ee + \frac{q^4 + mmaa - 2qqma}{kk}$ (that is, the square of $e + \frac{ma - qq}{k}$) equal to $aa - \frac{qqa}{b} + \frac{q^4 + mmaa - 2qqma}{kk}$; therefore the proportion will be, $kk : kk + mm :: aa - \frac{kkqqa}{bkk + bmm} - \frac{2qqma + q^4}{kk + mm}$ to the square of $e + \frac{ma - qq}{k}$; which proportion may be reduced to an easier equation, if, putting $kk + mm = pp$, it be $\frac{ky}{p} = a$; for at length it becomes the square of $e - \frac{qq}{k} + \frac{my}{p} = yy - \frac{qqky}{bp} - \frac{2qqmy}{kp} + \frac{q^4}{kk}$; which equation you will find to answer to the above construction, and you will at the same time observe, that to which soever of the lines E A, A B, B E the sum of the analysis be referred, the same sections may be always had, tho' in a longer way about, and in very different equations: From this construction may be deduced by analogy the effection of the other problem; *viz.* when the point is sought, from which a reflected ray may be parallel to any given line; as, if the luminous point B Fig. 14. being given, and the circle from the centre A, the reflected ray parallel to the right line A E were required; for it is the same thing, as if the distance of the points A and E were supposed to be infinite; in which case a third proportional to E A and F A would become equal to nothing, and the points A and U would coincide; therefore U X would be equal to A X, and A E be parallel to P E; apply then the preceeding construction, and you will have the solution, *viz.* describing the hyperbola X P from the vertex X, with the *Latus Transversum* U X or A X; and the *Latus Rectum* equal thereto, whose applicates to the diameter A X let be parallel to the right line A E.

The problem of *Alhazen* further considered by M. *Huygens:* The circle being given, whose centre is A, Fig. 15, the radius D A, as also the two points B and C, to find the point H in the circumference of the given circle, from which drawing H B and H C, they may make at the circumference equal angles.

Sup-

Suppose the point found, drawing the right line A M, which may bissect the angle B A C, let H F be drawn perpendicular thereto, as also B M and C L, join A H, to which let H E be perpendicular, and let A M meet in the points K and G the right lines B H and B C; now let $AM = a$, $MB = b$, $AL = c$, $LC = n$, the radius $AD = d$, $AF = x$, $FH = y$; since the angles K H E and C H Z or E G H are equal, and E H A a right angle, it will be, as K E to E G; so is K A to A G; but because, BM is to MD, as HF to FK, it will be, as BM + H F to H E, so is MF to FK; that is, $b + y : y : : a - x : \frac{ay - xy}{b + y}$, add $FA = x$, and it is $KA = \frac{ay + bx}{b + y}$: Again, because CL is to LG, as HF to FG; it will be by permutation and division, $CL - HF$ to HF, as LF to FG; *i. e.* $n - y : y : : c - x : \frac{cy - xy}{n - y}$, which substracted from $AF = x$, it is $GA = \frac{nx - cy}{n - y}$; but $EA = \frac{dd}{x}$; because F A, A H, A E are proportional; therefore $EA - AG$, that is $EG = \frac{dd}{x} - \frac{nx + cy}{n - y}$; and $KA - EA$, that is, $KE = \frac{ay + bx}{b + y} - \frac{dd}{x}$: But it was said, that K E is to E G, as K A is to A G; that is $\frac{ay + bx}{b + y} - \frac{dd}{x} : \frac{dd}{x} - \frac{nx + cy}{n - y} : : \frac{ay + bx}{b + y} : \frac{nx - cy}{n - y}$; whence it is found, $2anxxy + 2bnx^3 - ddbnx - ddnxy - 2acxyy - 2bcxxy + ddbcy + ddcyy = naddy + nbddx - addyy - bddxy$; and because $n = \frac{bc}{a}$, it is $\frac{2bbc}{a}x^3 - \frac{bbddcx}{a} - \frac{2bbcyyx}{a}$, because $xx = dd - yy$; but it is $\frac{2bbc}{a}x^3 = \frac{2bbcddx}{a} - \frac{2bbcyyx}{a}$, because $xx = dd - yy$; therefore $\frac{-2bbcxyy}{a} \frac{-ddbcxy}{a} - 2acxyy + ddcyy = -addyy - bddxy$; and dividing all by y and multiplying by a, $-2bbcxy - ddbcx - 2aacxy + ddacy = -aaddy - abddx$, $abddx - cbddx + acddy + aaddy = 2aacxy + 2b$

$+2bbcxy$, $\frac{abddx - cbddx + acddy + aaddy}{2aac + 2bbc} = xy$, which is the equation for the hyperbola; or becauſe, $bc = na$, $\frac{abdd - anddx + acddy + aaddy}{2aac + 2bbc} = xy$; let $\frac{add}{aa + bb} = p$, therefore $\frac{pbx - pnx + pcy + pay}{2c} = xy$.

Whence moreover the following conſtruction is eaſily found, join B A and A C, Fig. 16. and dividing ſeparately by both the ſquare of the radius A D, let the quotients be A P, and A Q; and joining P Q, let it be biſſected in R, and thro' R draw R D and R N, cutting each other at right angles; of which let R D be parallel to A D, which ſhall biſſect the angle B A C; now R D and R N will be the aſſymptotes of the oppoſite hyperbola's, one of which ſhould paſs thro' the centre A, and they will cut the periphery in H H, the points ſought, and the hyperbola's will paſs thro' the points P and Q: The reaſon of the conſtruction is manifeſt; for drawing P γ and Q ζ perpendicular to A M, it is A $\gamma = \frac{add}{aa + bb}$ or p; and A $\zeta = \frac{ap}{c}$; alſo P $\gamma = \frac{pn}{c}$, and Q $\zeta = \frac{pb}{c}$; wherefore A O $= \frac{pc + pa}{2c}$ and O R $= \frac{pb - pn}{2c}$; whence the reſt is eaſy.

Further conſidered by M. *Sluſius.* ——— It is not to be wondered at, that, in the problem of *Alhazen*, the ſame conſtruction may be deduced from different equations, ſince ſuch as have been all along uſed are contained in one and the ſame general analyſis; to prove which, let the circle be given, whoſe centre is A, Fig. 17. as alſo the points H and I, and let K be the point ſought, to which from the points H and I let the right lines H K, I K, and the tangent K D be drawn; then from A draw A G, meeting H K in E, I K in B, and the tangent K D in D, (producing ſuch lines as ought to be produced) ſuppoſing all this, it is plain, on account of the equal angles E K D, D K B and the right angle A K D, that the three lines A E, B E, D E will be always harmonically proportional; therefore drawing to A E the perpendiculars K C, I F and H G, and denominating A K $= q$, A C $= a$, C K $= e$, H G $= b$, A G $= d$, F A $= z$, F I $= n$, you will have, by the method M. *Sluſius* uſed formerly in the ſecond analyſis of this problem, this general equation, $nd\,aa - bz\,aa - nqqa + bqqa$ $= nd$

$= ndee - zbee + 2bnae + 2zdae - dqqe - zqqe$; now suppose, AG to be perpendicular to HI, there will be no variety in the equation, only that AF and AG, that is, d and z, will be equal; substituting d for z, it will be $ndaa - bdaa - nqqa + bqqa = ndee - dbee + 2bnae + 2ddae - 2dqqe$; or, dividing all by $nd - db$; $aa - \frac{qqa}{d} = ee$; $+ \frac{2bnae + 2ddae - 2dqqe}{nd - db}$; the same equation M. *Slusius* had deduced from his first analysis, tho' in a different manner: Suppose again, that AG coincides with AH, then HG or b will become nothing; expunging therefore the terms of the equation, in which b is found, there will remain, $ndaa - nqqa = ndee + 2zdae - dqqe - qqze$: Let us suppose the right line AG to bissect the angle HAI; it will be, on account of the similar triangles HAG, and IAF, as HG to GA, so IF to FA; or, as $b : d :: n : z$, and $nd = bz$; taking away equals, it is, $bqqa - nqqa = 2bnae + 2zdae - dqqe - qqze$, the very same that M. *Huygens* constructed; in fine, suppose the same right line AG bissect the right line HI, in that case HG and IF will be equal, that is, $b = n$; and it will be, taking away equals, $bdaa - bzaa = bdee - bzee + 2bbae + 2zdae - dqqe - qqze$; which, tho' not very difficult, has not yet been constructed; both these, as also the general equation itself, may be divided into two others, putting, for aa or ee, its value $qq - ee$, or $qq - aa$.

M. *Slusius* adds a construction by a parabola in a twofold manner, which tho' it seem more operose than the others by the hyperbola, yet the simplicity of this curve compensates the trouble; having the same *data*, join AI, Fig. 18. and produce it to S, till AS be equal to AH; joining HS and bissecting IS in M, draw thro' M the right line RMQ perpendicular to HS, on which let fall from A the perpendicular AQ, and let the radius AC be parallel thereto; then making IA, AC, AE three proportionals, let it be as SA to AE, so MQ to AD, and RS to AP (in the right line AQ towards Q) and in the same right line on the other side take DO equal to AC, and bissecting PD in X, let the right line UXL, meeting the perpendicular erected at D in the point U, be inclined thro' X in a half right angle to AX, and let fall from O on the same UXL the perpendicular OB; then, if it be, as UX to XB, so XB to BL, L is the vertex, LU the axis, XU the *Latus Rectum* of the parabola, which in every case satisfies the problem, *viz.* cutting the

the given circle in the points K K, the highest and lowest of which belong to the problem of *Alhazen*, and the remaining to another problem.

There is also given another parabola, which, as was hinted above, does the like, and whose description is so easily deduced from this, that there is no occasion for a new one; for let A δ be taken in the same right line with A D and equal to it, and A ω in the same right line with A O and equal thereto; then bissecting P δ in ξ, draw thro' ξ the right line $\varkappa\,\xi\,\beta$ perpendicular to X B, meeting $\delta\varkappa$ a perpendicular to O A in $\varkappa$, and on it let fall the perpendicular $\omega\,\beta$; and let it be, as $\varkappa\,\xi$ to $\xi\,\beta$, so $\xi\,\beta$ to $\beta\,\lambda$; λ will be the vertex, $\lambda\,\xi$ the axis, $\varkappa\,\xi$ the *Latus Rectum* of the parabola, which will cut the given circle in the same points with the former.

The first Invention and Demonstration of a right Line equal to a Curve; *by Dr.* Wallis. Phil. Transf. N° 98. p. 6146. *Translated from the* Latin.

AS to the rectification of that curve, which Dr. *Wallis* calls the semi-cubical paraboloid, M. *Huygens* must be under a great mistake, when, in his *Horologium Oscillatorium* p. 71, 72, he would ascribe the first invention thereof to *John Heuraet* of *Harlem*, in 1659; for it is certain, that Mr. *William Neil* an *Englishman* had both discovered and demonstrated the same thing two years before; and after him the Lord viscount *Brounker* and Sir *Christopher Wren* gave also a demonstration thereof about the months of *June* and *July*, 1657; which was a thing well known here, and received with applause both by those gentlemen and other geometricians, who, before the institution of the Royal Society, were wont to meet on stated days at *Gresham College*, and read mathematical lectures there: And the Lord *Brounker* in the ensuing *August* communicated this by letter to Dr. *Wallis* then at *Oxford*, and at the same time sent his own demonstration of it; which the Dr. imparted to M. *Huygens*, and afterwards published in 1659, subjoining it to his treatise *de Cycloide*; wherein he gave an impartial account of the whole affair; so that it is surprising M. *Huygens* should make *Heuraet* the first inventor.

In 1658, Sir *Christ. Wren* had found out a right line equal to the curve of a cycloid and its several parts; which was then a thing well known, not only in *England*, but also in *France* and *Holland*; and in particular M. *Huygens* himself was not unacquainted with it, even before he knew any thing of M. *Heuraet's*,

as appears by his letter to Dr. *Wallis*; and it is allowed that Sir *Christopher* was the first inventor of this; yet he himself did not pretend to have been the first who found a right line equal to a curve; for he knew, and he owns as much, that Mr. *Neil* had discovered it the preceeding year; only he assumes this prerogative to himself, that he had rectified the first curve that offered; whereas Mr. *Neil* applied himself to find out a curve capable of rectification; it is true that this curve is of the family of the paraboloids, but no one before Mr. *Neil* took it into consideration; and it is as true, that both M. *Heuraet*'s and Mr. *Neil*'s is the very same curve.

Of Stones *in the* Bladder. Phil. Transf. N° 99. p. 6155.

M. *John Braun* of *Dantzick*, a gentleman of 71 years of age, had excessive pains for 2 ½ years in the *Penis*, with a continual burning strangury, till at last it came to a constant endeavour of going to stool, and of making water; which, a few days before he died, ended in a continual running of urine, with very sharp pain; after which, for about four days before his death, it was totally stopt: Upon opening his body, the following particulars were observed; the internal parts were all sound, but the bladder was found quite full of stones; the largest was of the bulk of a pigeon's egg, and weighed 206 grains; there were 16 of the larger sort, yet all differing in size; the rest, to the number of 22, were very small; the least stone weighed 3 grains, and the whole 38, weighed 4 ⅞ ounces; there was not a drop of urine in the bladder, for it had already made a considerable passage on the side of the orifice of the bladder; in the kidneys and ureters there was not found the least grain or sign of sand: Several of the lesser sort of these stones were triangular and quadrangular; and their flat sides were worn to a great smoothness, and their corners blunted; the matter of the stones was very compact, and like white clay; and tho' the several coats were discernible in one of them, yet they were not easily separable.

An odd Fœtus *without a* Brain; *by* M. Denys. Phil. Transf. N° 99. p. 6157.

THE body of this fœtus was well formed, and very fat; but the head was so deformed, that it frighted all that were present; it had no front; the two eyes were on the top of the face, very big, and almost without an orbit to lodge them in; the upper and hind part of the head was red, like coagu-

lated

lated blood, and reſembled the bottom of a calf's head, when cut and ſevered from the *Vertebræ* of the neck; upon examining this red fleſh, he found under it a bone, that proved a ſolid bone in the form of a ſmall oyſter, and not a hollow ſkull; he had it opened every way, but he found neither cavity, nor brains in it; it was only faſtened before to the bones of the face, and not behind to the *Vertebræ* of the neck; ſo that the marrow of the back-bone had no communication with the head; he purſued the optic nerves, and loſt them in this bone, which was in lieu of a *Cranium*, and no ways ſpungy, but very hard: It ſeems ſomewhat extraordinary, that a child could live nine months without brains, for M. *Denys* was told, that it was very lively and briſk in the womb, but died as ſoon as it came into the air.

An Account of ſome natural Curioſities *preſented by* Sig. Paulo Boccone *of* Sicily *to the* Royal Society. Phil. Tranſ. N° 99. p. 6158.

THE firſt were uncommon pieces of coral both red and white; ſome of which were ramified into ſolid maſſy bodies; others were coralline incruſtrations on woody ſticks or branches, and terminated in ſmall and tender buttons or flowers of coral; in ſome of which, *S. Boccone* affirmed, he found, upon ſqueezing them, a milky juice; and being himſelf at the coral-fiſhing in the channel of *Meſſina*, which ſeparates *Calabria* from *Sicily*, he relates that before the coral-fiſhers drew their nets out of the water, he plunged his hand and arm into the ſea, to feel whether the coral was ſoft under the water, before it was expoſed to the air, and found it entirely hard, except the round end, or button, abovementioned; which he found to conſiſt of five or ſix little cells, full of a white, and ſomewhat mucilaginous liquor, reſembling that milky juice, found in ſummer in the long cods of the herb, called *fluvialis piſtana foliis denticulatis*, mentioned by *Joh. Bauhinus*; this coralline juice he calls leaven, becauſe of its ſharp and aſtringent taſte, eſpecially when newly taken out of the ſea; but ſuch as are dried loſe their acrimonious, and retain only their aſtringent taſte; which change, he affirms to happen in about ſix hours after the coral is drawn out. As to the queſtion whether coral be a vegetable, M. *Guiſony* is of opinion, that it is ſo far from being a plant, that it is a mere mineral, conſiſting of much ſalt, and a little earth; and that it is formed into that ſubſtance by a precipitation of divers ſalts, which enſues upon the encounter

counter of the earth with thoſe ſalts; after the manner of the metalic tree, which in a little time is formed and increaſed by the ſettling and combination of mercury and ſilver, diſſolved in *Aqua-fortis*; and being afterwards thrown into common water, the parts of the mineral and metal unite with each other; which ſeems to be confirmed by an experiment on a ſalt of coral, which being thrown into water and there diſſolved, upon evaporating the water by a gentle heat, it was preſently coagulated, and converted into ſeveral ſmall ſticks, reſembling a little foreſt.

The ſecond piece of curioſity, was a certain ſtony ſcaly ſubſtance, that ſmelt of bitumen, complicated and laid together like ſo many membranes, and found in the mountains of *Hybla* in *Sicily*, near *Milelli*, neighbouring on the town of *Auguſta*, and the ancient *Megara*; if it be burnt at a candle, the bituminous ſcent is ſoon perceived; and it is affirmed, that when newly ſeparated from its mine or bed, it is flexible like paper; but being long expoſed to the air and ſun, becomes brittle; and the herbs that grow on this ſtem inſinuate their fibres and roots between its ſeveral coats.

Thirdly, an extraordinary *Sanguiſuga* or leech, found ſticking to the fiſh called *Xiphias*, or ſword-fiſh; it was about four inches in length; its belly white, cartilaginous and tranſparent; without head or eyes, that could be obſerved; inſtead of a head it had a very hollow ſnout encompaſſed with a very hard membrane, differing in colour and ſubſtance from the belly; and this ſnout it thruſts into the body of the fiſh, as ſtrongly as an auger is wound into a piece of wood, and it is filled full of blood to the very orifice; it hath a tail ſhaped like a feather, ſerving for its motion, and under it, two filaments or ſlender fibres, longer than the whole inſect, whereby it ſeems to cling about ſtones or herbs, and ſtick the cloſer in the body of the ſword-fiſh, faſtening upon thoſe parts only, where it is out of the reach of its fins: Within its belly he obſerved ſome veſſels, like ſmall guts, reaching from one extremity to the other; they ſeem to be the organs allotted for ſucking the blood, becauſe the ſnout is deſtitute of fibres and valves to ſuck with; whereas theſe veſſels have a motion reſembling that of a pump, wherein the ſnout ſerves for a ſucker, drawing the blood from one end to the other; and the belly of this inſect being framed ring-wiſe, this ſtructure ſerves to thruſt the ſaid internal veſſels into the orifice of the trunk, and draw them back again: As it torments the ſword-fiſh, ſo is itſelf infeſted by another inſect,

called

called a louſe, of an aſh-colour, faſtened towards the tail of this leech as firmly, as a ſea-ſnail is to a rock; it is of the bigneſs of a pea, and hath an aperture, whence many ſmall winding and hairy threads come out.

Fourthly, a parcel of ſal-armoniac gathered in a fiery eruption of mount *Ætna*, found on the ſurface of that ferruginous matter, that remained of the burnt minerals; ſome of this ſalt was as yellow as ſaffron; other ſome of a citron colour; ſome white and ſome greeniſh: This ſalt ſeemed to be factitious, and a concrete of nitre, ſulphur, and vitriol, burnt and ſublimed, and not pre-exiſting in thoſe caverns; for adding ſome of this ſal-armoniac to pulverized ſulphur and nitre, he found that it was ſo far from taking fire, that it manifeſtly hindred the accenſion of the brimſtone and ſaltpetre.

A ſubterraneous Fungus, *and a* Mineral Juice. Phil. Tranſ. N° 100. p. 6179.

THE *Fungus Subterraneus* is found in a rocky lime-ſtone ground, in a common about two miles from *Caſtleton*, in the peak of *Derbyſhire*, fifteen or ſixteen yards deep, in the *Old-man*, the name of a mine, covered with earth; there is no coal-bed within five or ſix miles of the place: This *Fungus* does not ſeem to have any conſtant ſhape, it is much like peat or turf, both in the ſooty colour and internal ſubſtance; only this is more clammy and tough, and dries not; ſome of this fungous ſubſtance is very ſoft and like jelly; the more ſolid pieces contain lumps of bitumen, which are very inflammable like roſin; it is very light, breaks firm, and ſhines like good aloes, and is not much unlike it in colour, ſave that it is darker and purpliſh; yet there is a great deal of it of a dark green colour; by diſtillation it yields an acidulous limpid water, then a white liquor, probably ſome of the oily parts precipitated; and in the laſt place, a copious yellow oil, not unlike that of amber or pitch: Whether this *Fungus* owe its original to a vegetable, or be a real concrete mineral juice, and a foſſil bitumen, is hard to determine; but the finding of it in an old mine, favours much the opinion of its being a vegetable ſubſtance; either the props of timber, uſed in lining and ſupporting the grooves, are thus changed, or certain *Fungus*'s grow out of them; that birch, of which there is great plenty, and whereof there have been vaſt foreſts in all the mountainous parts of *England*, will yield a bitumen, as limpid as the ſap that runs from

from it in tapping, if we now had the ſkill to extract it; *Pliny* is very expreſs *Hiſt. Nat. l.* 16. *c.* 18; and beſides, it is certain that much of that wood, if not all, which is dug in the high moors of *Craven*, which the people uſe there for candles, and call candle-wood, is no other than birch, as appears from the grain and bark; tho' it exſudates a roſin, which makes many pronounce it real fir-wood; whatever this bitumen of the *Fungus* be, it differs much from the *Aſphaltum* of the ſhops.

There is another mineral juice in theſe parts of *England*, reſembling cream both in colour and conſiſtence; it was found in great quantities at the bottom of a coal-pit, 49 yards deep: At *Sherif-hales* in *Shropſhire* is found in their iron mines, eſpecially in that called the *White-mine*, which yields the beſt iron-ſtone, commonly upon breaking a ſtone, a great quantity of a whitiſh milky liquor, incloſed in its centre; ſometimes they find the quantity of a hogſhead in one cavity; its taſte is ſweetiſh, only it hath a vitriolic and iron-like twang.

The Trochitæ *and* Entrochi, *deſcribed by Dr.* Liſter. Phil. Tranſ. N° 100. p. 6181.

THE ſtones figured like plants, and called *Trochitæ* by *Agricola*, and the compound ſtones called *Entrochi*, and in *Engliſh* St. *Cuthberd*'s beads, are, like the *Lapides judaici*; of an opake and dark coloured ſpar, tho' ſome of them are of a white ſpar or *Cawke*, as miners call it; they all break like flint, appearing poliſhed and ſhining: They are diſſolved by vinegar, which holds of all foſſils of what figure ſoever they be, providing they are broken into ſmall grains; and if the bottom of the veſſel hinder not, they will be moved from place to place by it: The figure of the *Trochitæ* is cylindrical; the outmoſt circle is in general ſmooth; both the flat ſides are thick, with fine and ſmall rays drawn from a certain hole in the middle to the circumference: Two or three of theſe *Trochitæ* joined together, make up that other ſtone, called *Entrochos*; the *Trochitæ* or ſingle joints are ſo ſet together, that the rays of the one enter into the furrows of the other, as in the ſutures of the ſcull: They are found in great plenty in the ſcars at *Braughton* and *Stock*, ſmall villages in *Craven*; Dr. *Liſter* never met with any larger than two inches about; there are others as ſmall as the leaſt pin; and others of all magnitudes between theſe two; they are all broken bodies; ſome ſhorter, ſome longer, and ſome of them real *Trochitæ*, that is, ſingle joints

joints only; he never found one entire piece much above two inches long, and that very rarely too; in ſome of the long pieces he reckoned about 30 joints; and as they are all broken fragments, ſo they are found ſcattered and lying confuſedly in the rock; which in ſome places, where they are to be had, is as hard as marble; in other places ſoft and ſhelly, as they call it, that is, rotten and waſhed with the moiſt air; and tho' in ſome places they are but ſprinkled here and there in the rock; yet there are entire beds of rock of vaſt extent, which for the moſt part conſiſt of theſe and other figured ſtones; as of bivalve, ſerpentine, turbinate, *&c.* as at *Braughton*: The injuries, they have received in their removal from their natural poſition, if not the place of their growth and formation, are manifeſt; for beſides their being all broken bodies, many of them are depreſſed and cruſhed, reſembling the real cracks of a ſtone or glaſs; again, ſuch ſtones, as conſiſt of many *Vertebræ* or joints, are ſtrangely diſtorted; ſometimes two, three, or more of the joints in a piece are diſlocated and out of their places; and ſometimes a whole ſeries of them; there are others twiſted like a cord; laſtly, ſome have their joints regular, but ſtuffed with a foreign matter: There is a great variety as to the thickneſs of the *Trochitæ*, or ſingle joints; ſome are ſo thin, that they are ſcarce the 24th part of an inch; others are a full quarter of an inch thick; of theſe latter he only found at *Stock*; between theſe extremes, there are joints of all proportions in divers pieces; but in one and the ſame piece, they are generally of an equal thickneſs: And there are ſlender and ſmall *Entrochi*, with as thick joints as the largeſt: There is alſo ſome difference in the ſeams of the joints; ſome are but apparently joined; for in diſtilled vinegar the ſeeming ſutures will vaniſh, as thoſe from about *Biresford* on the *Dove* in *Staffordſhire*; and others, and all thoſe from *Braughton* and *Stock*, are really jointed, and the ſutures indented, which indentures coming from the terminating rays are larger, according to the difference of the rays; yet even, equal, and regular: Generally the outmoſt circle of each joint is flat and ſmooth; yet there are many other differences to be obſerved; 1. The ſmooth jointed are of different thickneſſes as to their joints. 2. On ſome *Entrochi*, between one ſuture and the other, in the middle of each joint, are certain knots in a circle; the joints thus diſtinguiſhed are very deep and large, and very frequent at *Stock*. 3. There are likewiſe thoſe, with a circle of knots, which have many knots beſide on each joint, and look rugged. 4. Some, with much

much thinner joints, which yet have a circle of knots in the middle of each joint; and theſe alſo ſeem as if they were all knotted; and ſuch are only found at *Braughton*, as far as is hitherto known. 5. As ſome have but one circle of knots, and others are knotted all over the joint, and rough; ſo there are ſome others with a circle of larger knots in the middle of each joint, and a circle of leſſer knots on each ſide, cloſe to the border of the ſuture; theſe look very pretty, and are found at *Stock*. 6. Others between each ſuture, and in the middle of each joint ſwell with a circular edge. 7. A ſmooth *Entrochos*, with a large and emboſſed edge on the middle of one of the joints, and a much ſmaller on the middle of another joint; and this alternately. 8. The ſame alternate difference, only the joints much rounder and blunter; and here the joints are viſibly thicker one than the other. 9. The ſame, with alternate knotted edges. 10. A double edge in the middle of every joint; this makes the joints look as if they were exceeding thin and numerous, but really they are not ſo. 11. A double edge in the middle of every joint knotted by intervals, or, as it were, with indented edges: Some of the pieces, if not all, of theſe *Entrochi* are ramified, with leſſer branches from the greater, without any order; ſome have only few branches on a piece; others are ſo thick of branches, that they reſemble a ragged ſtaff; theſe branches are deep inſerted within the ſtem, and by being ſeparated, leave great holes in its ſides; the rays in the joints of the branches run croſs to thoſe of the ſtem; on thick ſtems are ſometimes very ſmall branches; but generally the bigger the ſtem, the thicker the branches; and ſome of theſe branches are branched again; the branches are diſtinguiſhed from the ſtem, by being a little crooked, and ſomething tapering: There are few pieces, beſides the branches, that are not exactly cylindrical; and among theſe few, ſome are tapering at both ends, and ſwelled much in the middle; others are figured like a kind of fruit, or *Lapis judaicus*, and are real *Entrochi*, and jointed, notwithſtanding this ſhape; upon a ſmall ſtalk of two or three joints, an oval bottom is ſuddenly raiſed, broken off alſo at both ends; there are alſo long and ſlender pieces with a little jointed button, hollow on the very top; it muſt not be forgot that they are perforated in the middle, and ſo they may be eaſily ſtringed like beads, whence the *Engliſh* name; and theſe holes are ſometimes filled with earth, and ſometimes they encloſe other *Entrochi*, which latter are ſometimes tranſparent; the holes are of different bores, but generally round; and

and yet there are great numbers of them at *Stock*, whoſe perforations are in the elegant faſhion of a cinquefoil; and the rays of the joints of theſe *Entrochi* are much deeper and fewer in number, than of any other yet obſerved; they are alſo ſmooth jointed: In theſe rocks are found certain rude ſtones, of the bigneſs of walnuts, with many impreſſions of *Trochitæ* upon them, as tho' they had been their roots; and when theſe have been a little cleanſed in vinegar, theſe impreſſions appear more than caſual; for, the ſubſtance that covers them, if not the ſtones themſelves, is ſpar, and the impreſſions are round holes with rays, reſembling thoſe holes the branches make in the ſides of the ſtem, when broken from them; ſome of them are like a pine-apple or cone, with a hollow bottom, and round about it five ſingle feet at equal diſtances; on the top is the round figure of an *Entrochos* broken off; the ſtone conſiſts of angular plates, *viz.* the bottom of five plates, called feet, the middle of five other plates, all of a ſexangular figure, and the top, of ſtone: Others are of a pyramidal form, the bottom convex, and on the top is the impreſſion of an *Entrochos* broken off, and in the figure of a creſcent; this ſtone is alſo incruſtated, or covered with ſexangular plates, which are rough: Of theſe figured plates, there are great variety in the rocks, broken off, and heaped together in great confuſion, which yet manifeſtly belong to the above deſcribed ſtones; ſome of the faireſt at *Braughton* and *Stock* are pentagonal, and as broad as a thumb-nail, hollow on the ſide like a diſh, and convex on the other ſide, where are certain eminent knots, about the bigneſs of a ſmall pin's head, ſet in a kind of ſquare order; this plate is ſomewhat thin at the edges, and blunt; others are pentagonal, and a little convex above, but not hollow underneath; and without theſe eminent knots, the edges are thin and ſharp; others of theſe pentagonal plates are convex on one ſide, and ſomewhat hollow on the other; thick edged, and one of the five ſides only indented, which is ever the thinneſt; there are many amongſt theſe laſt indented ſorts of plates, which are channelled on the concave ſide, and otherwiſe notched: One of theſe pentagonal plates from *Wansford* bridge in *Northamptonſhire*, has one of the five ſides thick indented; the convex part has in the middle a raiſed boſs, like ſome ancient ſhields, and round the ſides a liſt of ſmaller ſtuds: The ſexangular plates are ſmall, ſave here and there one; ſome of them are a little hollow on the one ſide, and convex on the other; which latter is elegantly emboſſed, that is, an equilateral triangle beſtriding

each corner, and a ſingle right line in the middle; others, which are moſt common in theſe rocks, are a little hollow on the one ſide, and convex on the other; they are generally ſmooth on the convex ſide; ſome are thicker than others, but moſt of them are of the form of plates; the ſides are very unequal, as in cryſtals; ſometimes five broad ſides, and one very ſmall; again, two broad ſides, and four others much narrower, with infinite other differences as to the inequality of their ſides.

Mr. *Ray* relates that there are found in *Malta* certain ſtones, called St. *Paul's Batoons*, which he ſuppoſes originally to have been a ſort of rock-plants, like ſmall knobbed ſticks, but without any joints; their trunks diminiſh in the ſame manner as other plants after the putting forth of their branches.

An Account of Lead Sheathing; *by Mr.* J. Bulteel. Phil. Tranſ. N° 100. p. 6193.

ANNO 1674, ſome years ſince, Sir *Phil. Howard* and *Major Watſon*, with great charge and induſtry found out a new way, by an *Engliſh* manufacture, to preſerve the hulls of ſhips from worms, &c. which is much ſmoother and conſequently better for ſailing; cheaper and more durable than the method of boards, pitch, tar, roſin, brimſtone, or any ſheathing or graving hitherto uſed: The king and parliament being ſatisfied, upon examination, of the great benefit that might redound thereby to his majeſty and ſubjects in general; for the inventors encouragement to make the ſame publick, were pleaſed, almoſt four years ſince, to grant them an act of parliament for the ſole uſe of this their invention, with a penalty and prohibition to all others: In purſuance whereof, experiments have been made upon ſeveral of his majeſty's ſhips, and the ſheathing after three years was found to be in as good condition, as at the firſt doing; and the ſhip ſo tight during the whole time, that they were obliged to heave in water to keep her ſweet: The bread-rooms alſo of ſeveral of his majeſty's ſhips were lined within, almoſt in the ſame manner as they were ſheathed externally, whereby the bread was greatly preſerved; and on account of its durableneſs it muſt be cheaper and better than tin, which is ſo liable to ruſt: Alſo the lead itſelf, which is the principal thing uſed therein, being ſo cloſely preſſed ſmooth and equal, and of any degree of thickneſs, great uſe may be made of it in ſeveral other things relating to ſhipping.

A Deſcription of Nova Zembla. Phil. Tranſ. N° 101. p. 3.

AN. 1674. It appears by a new map of *Nova Zembla* and *Weigats*, as diſcovered by the expreſs order of the *Czar*, that *Nova Zembla* is not an iſland, as hitherto has been thought; and that the *Mare Glaciale* is not a ſea, but a *Bay*, whoſe waters are ſweet; which is alſo affirmed by the *Tartars*, who have taſted of theſe waters in the very middle of the bay: The *Samojeds* as well as the *Tartars* unanimouſly agree, that paſſing on the back of *Nova Zembla*, at a conſiderable diſtance from the ſhore, there is a paſſage as far as *Japan*; and it is a fault in the *Engliſh* and *Dutch*, that ſeeking a paſſage to *Japan* on the ſouth of *Nova Zembla*, they have generally paſſed the *Weigats*: The *Weigats* itſelf is very difficult to paſs, becauſe of the great quantity of ice falling into it from the *Oby*, whereby the ſtreight paſſage is ſtopped up: The *Samojeds* go every year to fiſh on the ſaid ſweet ſea and that on *Nova Zembla* ſide.

Volatile Salt *and* Spirit *extracted out of all Sorts of Plants*; *by Dr.* Dan. Cox. Phil. Tranſ. N° 101. p. 4.

TAKE in warm weather a conſiderable quantity of the leaves of any vegetable, ſtripped or pulled from the great ſtalks; lay them on a heap, preſs them pretty cloſe together, and they will ſoon become very hot, eſpecially in the middle; and after a few days reſolve into a pappy ſubſtance, excepting the outward leaves, which made into pellets and put into a glaſs retort, and diſtilled, will yield, beſides a great quantity of liquor, much thick black oil of the conſiſtence of a balſam; the liquor being ſeparated from the oil and diſtilled in a tall glaſs-body, there is a volatile ſpirit ſublimed, which, after two or three rectifications, becomes perfectly urinous, and not to be diſtinguiſhed by ſmell or taſte from well rectified ſpirit of hartſhorn, blood, urine, or ſal-armoniac: Dr. *Cox* never made trial of any herb, which thus ordered, did not yield the abovementioned ſubſtances; even moſſes and rudiments of vegetation do the like, which laſt is a green ſubſtance on the ſurface of the earth, in rivers, ciſterns, where rain often falls, and on ſhips between wind and water, very apt to run into moſs and fibres.

Note 1. The veſſels wherein theſe diſtillations were performed, tho' exceedingly well waſhed with water, ſcoured with common ſalt, ſand, aſhes, ſoap, fixt ſalts, *&c.* and afterwards expoſed many years to the air, wind, rain, dews and froſts, yet notwithſtanding they retained a very ſtrong ſcent, not unlike muſk

muſk. 2. The water left at the bottom of the glaſs, after the firſt rectification, was ſomewhat acetous; eſpecially when the herbs were not ſufficiently fermented. 3. If the herbs are duly fermented, they leave but little *Caput Mortuum*, ſometimes not a twentieth, and never by his trials above a tenth part; whereas, diſtilled before fermentation, they leave much more; and this remaining coal, burnt to aſhes, yields ſcarce any alcali or fixt ſalt. 4. The volatile is in greater quantity than the fixt ſalt would have been, if the herbs were incinerated in the ordinary way. 5. All ſuch herbs as yield much fixt ſalt, as wormwood, carduus, mugwort, ſage, &c. do likewiſe, being thus managed, afford plentifully a volatile ſalt. 6. Theſe volatile ſalts, when highly rectified, did not differ from each other; as neither do vinous ſpirits of fermented vegetables, or their fixt ſalts highly purified and rectified. 7. During the fermentation the room would at firſt be ſtrongly perfumed with the natural ſcent of the herb, if it had any eminently peculiar ſmell; in the middle, with the ſcent of a mixt between that and the urinous; but when putrified well, it became ſenſibly urinous. 8. The diſtilled liquor of ſome herbs, at the firſt rectification, yields a very hot ſpirit; but the laſt inclines rather to the pungent vinous ſpirits of ſcurvy-graſs, horſe-radiſh, &c. biting like pepper, rather than volatile ſalts; but after repeated rectifications, according to the nature of the plant, or the time of its fermentation, it became perfectly urinous; which was uſually when the herbs were not duly fermented; ariſing probably from ſome mixture of eſſential oil, which, by reiterated rectifications, is either ſeparated or tranſmuted; the ſame thing happens in the vinous ſpirits of fermented vegetables, and in their fixt ſalts. 9. In diſtilling putrefied herbs, the urinous ſpirits and ſalt came chiefly at the latter end with the oil, in the form of a thick white cloud or fumes, and condenſing in the receiver, formed ſeveral irregular winding rivulets, exactly in the manner of harts-horn, blood, &c. and at firſt the phlegm with moſt of the vinegar came in great drops with ſome fume, and the rivulets were ſtreight without any windings. 10. Some herbs as winter-ſavory, ſage, &c. yielded in the firſt diſtillation a copious volatile ſalt in a dry form, which coated the receiver, and was ſublimed into the neck of the retort; the ſame tobacco doth, and ſaffron did ſo once in digeſtion with ſpirit of wine. 11. All plants thus fermented, yielded plentifully, eſpecially towards the latter end of the diſtillation, a foetid groſs oil, which, in caſe the herbs were well putrefied, did not in the leaſt reſemble the plant that produced it, and they could

could hardly be perceived to differ from each other, either in taſte or ſmell; only if the plant was not thoroughly fermented, an oil would come over at the beginning of the diſtillation, which, as alſo the phlegm, would retain exactly the taſte and ſmell of the vegetable, which afforded it; and would be fluid and tranſparent like other eſſential oils: The oil of herbs ſufficiently putrefied came over chiefly at laſt, and required a very ſtrong fire to diſentangle it from the herbs; it was generally, eſpecially what came over laſt of all, of the colour and conſiſtence of tar, very clammy, and emitted to a great diſtance a very odd, faint, foetid offenſive odour: If any thing were ſtained with this oil, it could not be taken out in a long time. 12. Herbs diſtilled in an alembic with water yield little eſſential oil, as balm, mint, camomile, &c. but fermented thus they afford much of it; and ſuch as yield much eſſential oil, as wormwood, with many others; when putrefied, afford it in greater plenty ſtill. 13. During the putrefaction, the herbs became exceedingly hot, eſpecially ſuch as were cloſely compreſſed, and abounded in moiſture; ſo that one could as well hold his hand in the flame of an ordinary fire as in them. 14. Fatty, moiſt and inſipid herbs, ferment much ſooner, and with greater heat; as graſs, docks, garden ſcurvy-graſs, celandine, &c. Drier and much more ſapid plants, more leiſurely, and with leſs heat; as winter-ſavory, roſemary, ſage, rue and mint: No ſtalks of herbs ferment ſo ſoon as the leaves; which appears plainly in docks, whoſe tender parts are mucilaginous and pappy, while the ſtalks remain entire. 15. Herbs by putrefaction ſeem to be deprived of all their ſpecific or peculiar properties; celandine looſes its tinging quality; the milk of ſpurge its bliſtering and poiſonous nature, &c. 16. Herbs, which before putrefaction, were extremely fœtid, as *Atriplex Olida*, &c. either loſt afterwards their ſcent, or were not diſagreeable; and on the contrary, monk's rhubarb, garden ſcurvy-graſs, with many other inodorous vegetables, during putrefaction, became intolerably fœtid; but upon diſtillation they immediately loſt their diſagreeable ſcent. 17. None of thoſe flowers Dr. *Cox* hitherto uſed did ſtink in fermentation. 18. Many of the herbs, thus putrefied or fermented, ſwarmed with maggots; eſpecially at the bottom, and in the middle; whither flies and other inſects can have no acceſs to depoſite their eggs, and where the heat is ſo violent, that they could not poſſibly ſubſiſt in it. 19. Yet the volatile ſpirit and ſalt is not afforded by theſe inſects; for diſtilling ſeparately a great quantity of them, they yielded no volatile ſalt or ſpirit, but a liquor of a

very

very different nature. 20. Herbs fermented in a great glaſs with a narrow neck, and the mouth left open, became in a few weeks, for the greater part a mucilage; and being diſtilled a year after they had ſtood thus open, yielded a little urinous ſpirit, but not a drop of oil. 21. Vegetables, if the external air be excluded from them, will not putrefy or ferment. 22. Some herbs, moſſes and rudiments of vegetation, yield a volatile ſalt, diſtilled without previous fermentation; as alſo many ſeeds, and ſeveral of them ſufficiently inſipid. 23. Theſe volatile ſpirits and ſalts have not only the ſame ſenſible properties, but alſo agree in all known effects and operations with common urinous ſpirits and ſalts; as, in the changing ſyrup of violets, and many other vegetable tinctures, green; in being diaphoretic diuretic, and deobſtruent, contrary to and blunting acids, precipitating all metals and minerals diſſolved in acid menſtruums; when highly rectified and mixed with perfectly dephlegmated ſpirit of wine, they ſtrike the *Offa Alba*, as *Chemiſt's* ſpeak; they unite with acids, and thereby become armoniac, or neutral ſalts; and indeed perform whatever can be expected from the common urinous ſpirits or ſalts.

Stones *in the Bladder of an* Ox; *by Dr.* Johnſton. Phil. Tranſ. N° 101. p. 9.

ABOUT 200 ſmall globular ſtones of ſeveral ſizes, with a duſky froth, were obſerved in the bladder of a fat ox; on rubbing the ſlimy froth from them, they appeared of a duſkiſh yellow colour and ſmooth; when dry, they reſembled ſeed-pearl, but were ſmoother, and of a perfect gold colour, and continued ſo; viewed in a microſcope, they appeared poliſhed, and without any roughneſſes; their figure was generally ſpherical, in ſome a little compreſſed, and their colour like burniſhed gold; breaking one or two of them with ſome difficulty, they were found by the microſcope to be only a thin ſhell very bright, and its inſide like unpoliſhed gold; the internal ſubſtance reſembled brown ſugar-candy to the naked eye, but not ſo tranſparent, and without any diſcernable taſte: In ſpirit of vitriol they ſhrunk and waſted much, but preſerved their colour; *Aqua fortis* would alſo corrode and diſſolve them.

Dr. *Liſter* was at firſt of opinion that theſe ſtones were the eggs of inſects; but after he had read that acconnt of ſeveral ſtones found in other animals, which Dr. *Wedelius* publiſhed in the *German Ephemerides*, *An.* 1672, he was inclined to believe them real ſtones.

The

The Origin of Pearls; *by M.* Chriſtopher Sandius. Phil. Tranſ. N° 101. p. 11.

THE pearl-ſhells in *Norway*, and elſewhere breed in freſh water; their ſhells reſemble thoſe commonly called muſcles, but larger; the fiſh in them looks like an oyſter, and produces a great cluſter of eggs, reſembling thoſe of craw-fiſh; ſome white and ſome black, and this latter becomes white, on taking off the outer black coat; theſe eggs, when ripe, are caſt out, and grow, becoming like to the parent animal; but ſometimes it happens, that one or two of theſe eggs adhere to the ſides of the matrix, and are not voided with the reſt; theſe are fed by the oyſter againſt its will, and become, according to the length of time, pearls of different bigneſſes, and impreſs a mark both on the fiſh and ſhell. This account M. *Sandius* had from a *Dane* called *Henricus Arnoldi*, a perſon of veracity, and who had made the obſervation himſelf at *Chriſtiana* in *Norway*.

Microſcopical *Obſervations*; *by M.* Leewenhoeck. Phil. Tranſ. N° 102. p. 23.

BLOOD viewed thro' a microſcope appears to be ſmall round globules ſwimming in water; and the ſame thing is obſerved of the ſweet milk of cows: The hair of an elk is found wholly to conſiſt of conjoined globules; ſo that the growth of hair is made by the protruſion of theſe globules; and this hair is obſerved more hollow within than that of men or other animals: M. *Leewenhoeck* found the nails of his hand to conſiſt of globules, which he ſuppoſes to grow alſo by protruſion: Putting a hungry louſe upon his hand, he obſerved it to fix its ſting in the ſkin, and when it ſucked, the blood appeared to paſs in a fine ſtream to the forepart of the head, and then to fall into a larger round place, which he takes to be filled with air, which, being half full, propels the blood backward, and the air again forward; from thence the blood paſſes in a fine ſtream into the middle of the head, where is alſo a large round ſpace, where it hath the ſame motion; hence it paſſes in a ſubtile ſtream to the breaſt, and then to a gut, which reaches to the hindmoſt part of the body, and with a curvity bends a little upwards again; in the breaſt and gut, the blood is without intermiſſion moved with great force, and eſpecially in the gut, and that with ſuch a ſtrong pulſe downwards and contraction of the gut, as is ſurpriſing; in the up-

per part of the crooked aſcending gut, which is very ſtreight, the blood, that is propelled thro' this place, ſtands ſtill and ſoon receives another nature, becoming of a watry colour, wherein ſome blackiſh ſandy particles appear, which joining together in one maſs ſhoot down to the *Anus*, carrying with them, in caſe the louſe have much blood in her body, a little aqueous blood; theſe particles excreted appear like the excrements of a ſilk worm.

A Parhelium; *by M.* Hevelius. Phil. Tranſ. N° 102. p. 26.

FEB. 5. 1674. N. S. not far from *Marienburg* in *Pruſſia* M. *Hevelius* obſerved the ſun in a clear enough ſky, and ſtill ſome degrees above the horizon, ſhining very bright, and darting very long and reddiſh rays, 40 or 50 degrees towards the zenith, Fig. 19. Plate XIII. Beneath the ſun, towards the horizon, there hung a ſmall cloud ſomewhat diluted, below which appeared a mock-ſun of the ſame bigneſs with the true one, and under the ſame vertical, of a ſomewhat red colour: Soon after, the true ſun deſcending more and more towards the horizon, to the ſaid cloud Fig. 20. the ſpurious ſun beneath it grew ſtill clearer and clearer, ſo that the reddiſh colour in that apparent ſolar diſk, vaniſhed, and put on the genuine ſolar light, and the more ſo, as the genuine diſk of the ſun was diſtant from the falſe ſun; till at length the upper true ſun paſſed into the lower falſe one, and ſo remained alone, Fig. 21. This appearance is uncommon, ſince the mock-ſun was not found on the ſide of the true one, as uſual in all *Parhelia*, but perpendicularly under it; not to mention the colour, ſo different from that in ordinary mock-ſuns; nor the length of the tail projected by the genuine ſun; nor a far more vivid and ſplendid light than *Parhelia* uſe to exhibit. Upon this appearance there ſoon enſued a very intenſe froſt, whereby the whole bay from *Dantzick* to *Hela* in the *Baltick* was frozen up, that ſleds and horſes were driven on it for ſeveral miles.

Experiments on Vitriol, Sulphur *and* Alum. Phil. Tranſ. N° 103, p. 41.

VItriol is either white, yellow, green and blue, and uſually of the two laſt colours; and made either of mineral waters, boiled up to a convenient conſiſtence, then ſet to chryſtallize; or, extracted by common water out of earths impregnated therewith; it is alſo afforded by ſeveral ſorts of ſtones,

ſtones, commonly called pyrites and marcaſites; which expoſed for ſome months to the air, are reſolved into powder; and the ſaline part diſſolved in rain, or other water, then boiled and ſet to ſhoot, yields plenty of vitriol, eſpecially with the addition of copper or iron; it is often joined with earth and ſtones, which contain metals, ſuch as miſy, ſory, and chalcitis, from which it is uſually ſeparable by the common method with water; ſometimes not without calcining or burning the mineral; it is frequently found pure and perfect in the bowels of the earth, being an efflorеſcence of ſeveral minerals; and this is accounted by all naturaliſts the beſt, both for medicinal and chemical uſes; common mineral ſulphur contains it in great plenty.

Vitriol conſiſts of inſipid phlegm, earth or oker, ſome metal, mineral, ſulphur, an acid ſalt or ſpirit, together with ſome ſmall portion of the volatile aerial ſalt: That it contains water is evident, ſince no ſaline ſubſtance can cryſtallize without it, and by diſtillation it exceeds in quantity any of the other principles: The earth or oker may be thus ſeparated; diſſolve vitriol in fair water, and immediately a yellow powder will ſeparate and in a little time ſubſide; the greater the quantity of water employed, the more oker precipitates; the weaker the *Lixivium*, the leſs able it is to ſupport bodies more ponderous than common water; and the lighter the water, as diſtilled rain-water, or phlegm of vinous ſpirits, the more earthy parts ſubſide; this diſſolution was repeated above 20 times, accompanied with filtration and coagulation; and each time ſome of this earth was ſeparated, but inſenſibly ſmaller quantities; and *Baſilius Valentinus* aſſures that at length the vitriol will let fall no more ſediment: But the author found a more eaſy and expeditious way of effecting this ſeparation; take a good quantity of the common *Dantzic* or *Hungarian* vitriol; after powdering it, put it into a ſlender cucurbite, place it in water, keep it at an equal conſtant fire three or four days; the vitriol will, without addition, become fluid, as if diſſolved in water, and the oker with moſt of the metalline parts, and the groſs ſulphur, will ſubſide, and become a hard cake at the bottom; the vitriol being fluid about it, which again cryſtallizes in the cold: This repeated once or twice, the vitriol attains to a high degee of purity, and is eaſily capable of many alterations, to which it was not ſubject before this purification; this operation will not ſucceed in a dry digeſtion, he means, aſhes, ſand, filings of iron or ſteel, open

 fire,

fire, or even the flame of lamps, whether fed with oil or ſpirit of wine: This earth may be alſo obtained in a great proportion, tho' in another form; if after a long and intenſe calcination, the vitriol be freed from its remaining ſalt, by frequent ablutions with warm water; the far greater part of this dulcified colcothar is inſipid earth, with ſome ſmall proportion of metal: The ſame may be precipitated by ſalt of tartar, or any other alcali, or filings of zink, or other immature minerals, and from a ſolution of vitriol in common water.

That vitriol contains ſulphur appears from the ſulphureous ſmell it emits in diſtillation, eſpecially if urged with a ſtrong fire from the beginning; and the ſpirit thus drawn being rectified, the liquor which firſt riſes, hath a highly ſulphureous ſmell, as alſo that from vitriol deprived of its metallic parts: The colcothar dulcified, or metallic parts precipitated by an alcali, or immature mineral ſublimed with ſal-armoniac, an inflammable ſulphur may be ſeparated ſeveral ways, both from the ſublimate and *Caput Mortuum*: The common oil of vitriol digeſted on antimony, and then diſtilled, yields a much greater quantity of ſulphur, than would have been produced, had any other acid liquor been employed; and the ſame oil of vitriol digeſted with ſpirit of wine, and diſtilled, yields an oil, and at the latter end, a great deal of ſulphureous inflammable flowers.

As to the acid ſaline principle; none who has taſted of the ſpirit of vitriol, and that which is abuſively called its oil, will queſtion its abounding therein: In order to the reſolution of certain enquiries as to the ſaline principle, theſe experiments were made: He took four or five gallons of the vitriolate water, conveyed by artificial channels at *Deptford*, from the beds of pyrites or marcaſites into the great ciſtern; there was diſtilled from it in glaſs veſſels two thirds of inſipid water; letting the glaſſes cool, the water let fall a vitriol of a fine diluted colour, together with a great quantity of that yellow ſediment, called oker above; then evaporating a third part of the remaining liquor, he received more vitriol of a paler colour than the former; as oker, as he did before, tho' in leſs quantity; the fifth time this operation was repeated, inſtead of vitriol it afforded a yellow, and ever after a white ſalt; differing exceedingly from vitriol, not only in colour, but taſte, being fiery and pungent; it partakes a little of that diſagreeable rough aſtringency, which is peculiar to vitriol; it was alſo unctuous like ſalt of tartar; made the hands ſoft and ſupple, cleanſing like

ſoap;

ſoap; whereas common vitriol renders them rough; being diſſolved in water, it appeared fatty and oleaginous to the eye.

From 5 ½ pounds of *Lixivium*, 4 pounds of this fiery white ſalt were had; beſide half a pound of *Liquamen*, which remained fluid, and would not coagulate: The remaining *Liquamen* was very fiery, acidly pungent, and extremely ponderous; this *Liquamen* expoſed to the air, ſoon attracted double its quantity of moiſture: The white ſalt, laſt mentioned, was diſtilled in a ſand-furnace, and the far greater part came over in the form of a ſpirit highly acid, eſpecially that which came laſt in ſmall drops: This liquor rectified in a very tall body, immediately on the approach of the ſmalleſt degree of heat, a volatile ſulphureous ſpirit as clear as rock-water did ariſe, and almoſt inſipid; yet the ſcent ſo ſubtile and penetrating, that it was inſupportable; and ſuch it continued many years, without letting fall any ſediment, or loſing its ſtrength, as the volatile ſpirit made of common vitriol does; the ſpirit which remained after the ſeparation of the more volatile parts, was in all reſpects like that of *London* vitriol; only it ſeemed more gratefully acid, and might, like it, be ſeparated into ſpirit and oil, corruptly ſo called.

Vitriol freed from its earthy and metallic parts by zink, or other imperfect minerals, is much of the ſame nature, and yields its ſpirit in ſand; it is alſo white and more unctuous; hath a grain more like nitre than vitriol, as the *Goſlar* vitriol; which is white, and comparatively unctuous, becauſe it has little metal, and leſs mineral ſulphur than the common, whoſe metallic parts detain the ſaline, and will not diſmiſs them, till after a very intenſe degree of heat. What remained in the retort after this diſtillation, was not red or purple, like the *Caput Mortuum* of common vitriol, but white, light, and ſpongious, like burnt alum, and quite as inſipid; tho' after, being ſome time expoſed in the air, it received ſeveral impreſſions and alterations: There is a great affinity between vitriol, alum, and mineral ſulphur; the ſaline principle, which in each of them is the prevailing, has one and the ſame nature and properties.

A Continuation of the Experiments on Vitriol. Phil. Tranſ. N° 104. p. *66*.

THAT the vitriolate ſalt in common ſulphur, differs little from that of vitriol, will appear upon comparing with the common ſpirit, or oil of vitriol, the acidity of ſulphur afforded by inflammation under a glaſs bell; which, when rectified,

tified, is not to be diſtinguiſhed by any ſenſible property from the rectified acidity, or oil of vitriol; and they may be ſafely ſubſtituted for each other: The quantity obtained in the ordinary way, is indeed inconſiderable; a pound of brimſtone not yielding above an ounce or ten drachms; the far greater part being by the rapid motion of the flame ſublimed in the form of flowers, not differing from the common; but the author was often aſſured, that, by means of conveniently ſhaped veſſels, ordinarily from a pound of good brimſtone, eight, and in a very moiſt ſeaſon, ten ounces of acidity have been obtained; and that by improving the contrivance, the entire weight of the ſulphur could be obtained; the moiſture of the air making abundant recompence for the avolation of what cannot be coagulated; and he himſelf, by the means of ſeveral menſtruums, reduced common brimſtone into the form of an highly acid corroſive liquor; and even ſpirit of nitre, or *Aqua-fortis* well rectified, and digeſted on the flowers of brimſtone, then diſtilled in aſhes, repeated five or ſix times, after the laſt cohobation, there will remain with the flowers near their weight of an acid ſpirit, and like to that made by a bell, the ſpirit of nitre being ſcarcely changed from what it was before the operation; and he ſuppoſes, that being frequently reiterated, eſpecially if freſh ſpirit be employed, the whole may be tranſmuted, abating ſome few earthy and metallic particles.

The affinity, or almoſt the identity of the ſaline principle in ſulphur and vitriol, appears farther from the following experiment; take thin plates of copper, cement them carefully with common brimſtone *Stratum ſuper Stratum*, or in layers; repeat the operation for four or five times with freſh ſulphur; the greateſt part of the copper will be converted into vitriol, which, diſſolved in water, yields very beautiful azure cryſtals after evaporation; the ſame may be effected with iron: Or, moiſten filings of copper or iron with the acidity of ſulphur, corruptly called its oil; then free them from ſuperfluous moiſture by fire or air; repeat this twice or thrice, and afterwards you may extract with common water a fair vitriol; and the ſame metals diſſolved in any acid menſtruum, and cryſtallized, are converted into vitriol.

The affinity between vitriol and natural alum appears thus; vitriol is ordinarily found in the ſame vein, and ſometimes in the ſame parcel, which yields alum, and may be ſeparated from each other by ſeveral methods; and indeed they are ſo nearly allied, that by ſome pretty artifices alum may be converted

verted into vitriol, or vitriol into alum: Alum, diſtilled into an acid ſpirit with copper or iron, becomes good vitriol; and vitriol freed from its metallic parts becomes aluminous; and diſtilled, yields a ſpirit not diſtinguiſhable by the niceſt ſcruting from that of alum; and what illuſtrates this affinity; the author often obſerved rectified oil of vitriol and ſpirit of ſulphur to coagulate, and become ſolid tranſparent concretions, exactly reſembling cryſtallized alum.

As for the ſaline principle of ſulphur, the author concludes it to be common ſalt, which together with the ſalt in the air, is the foundation of all ſaline ſubſtances in the univerſe; and he aſſures, he could with common ſalt make both vitriol and alum, hardly diſtinguiſhable from the natural.

Directions for tanning Leather, *and a* Machine *for beating and cutting the* Materials. Phil. Tranſ. N° 105. p. 93.

EVERY part of the oak-tree, of what age or growth ſoever; and all oaken coppice-wood, of any age or ſize, cut and procured in barking-time, will tan all ſorts of leather as well at leaſt, as bark alone; and this, when got in its proper ſeaſon, muſt be very well dried in the ſun, and more ſo than bark; then it is to be houſed dry, and kept for uſe; and when it is to be uſed, the greater wood may be ſhaved ſmall, or cleft, to be fit for the engine to be deſcribed below; and the ſmaller is to be bruiſed, and cut ſmall by the ſame engine; after which it muſt be well dried on a kiln, and then ground, as tanners uſually do their bark: Such wood, as is to be uſed preſently after getting it, will require more drying, otherwiſe it will blacken and ſpoil all the leather: Where oak is ſcarce, thorns may pretty well ſupply its place: Birch, ordered and uſed inſtead of oak, is very fit for ſole-leather: As theſe ingredients will tan better than bark alone, and that with far leſs charges; ſo this invention may ſave the felling of timber, when the ſap is up; which, when it is done, cauſes the outſide of the trees to rot, and grow worm-eaten; whereas had the trees been felled in winter, when the ſap was down, they would have been almoſt all heart, and not ſo ſubject to worms; beſides, that this invention will greatly improve the value of under-woods.

The machine is repreſented Fig. 22. 23. 24. Plate XIII. and conſiſts of a long ſquare wooden block, which is beſt of oak or elm; and of ſome pieces of iron to be faſtened on it, and uſed about it, *viz.* an anvil, a hammer, an iron holding the wood to be bruiſed and cut, and a knife: A B, Fig. 22, the length of the block,

block, about 4 foot; CD the breadth, 15 or 16 inches; EF the depth, 8 or 10 inches; GHIK a ſquare cavity, to receive a plate of iron, ſerving for an anvil, to beat and bruiſe the tanning materials thereon; which is to be about 4 inches deep, 9 inches broad, and 12 inches long; LMNO the iron for claſping and holding faſt the materials to be bruiſed and cut; which muſt lie croſs the engine, about the middle of the ſaid piece of timber, and it may be about 3 inches broad; PQ are two hooks at one end of it, which are turned upwards, and muſt be hooked into the loops of the two hinges that are let in, and faſtened to the ſide of the engine RS, in ſuch a manner that this claſping-piece may be a little raiſed for putting the tanning materials under it; at the other ſide T in Fig. 23. is a ſingle hook, turned alſo upwards, to hang a weight upon it, whilſt the ſtuff is a bruiſing by the anvil, or a-cutting by the knife; the button in Fig. 22. ſerves to take up this piece by; *aaaa* on the other ſide of the block, Fig. 23. are the places for the four feet of this engine, which are to be of a convenient height to work upon it; *b*, Fig. 24. is the hammer for beating and bruiſing the ſtuff, which may be of 6 pound weight, and the head about 3 inches ſquare, to work with both hands; but for one hand, it may be of 3 pound weight, and the head about 2 inches ſquare; the ſurface of one end of theſe hammers ſhould be ſmooth; but that of the other, indented; they are to be well ſteeled at both ends; the handles may be about a foot long; the larger ſhould be a little longer: *cd*, Fig. 22. the knife for cutting the bruiſed ſtuff, which muſt be 8 or 9 inches broad, and near as much in depth, made like a tobacco-knife with a handle, and faſtened to the block at the two oppoſite ſides, that are to be hollowed with two grooves *efgh*, Fig. 23. and *iklm*, Fig. 22. with two pieces of iron fitted in the grooves to hold and guide the knife in cutting; the one piece *nopq*, Fig. 22. is to be faſtened to the end of the knife *c* by a pin *r*, paſſing thro' three holes; and this end is to be ſcrewed into the groove *efgk*, Fig. 23. by a couple of ſcrew-pins; the other piece, *ſtuxyz*, Fig. 22. being forked, is to receive the other end of the knife *d*; and the ſolid ſquare part thereof *iklm* is to be faſtened in the groove under it, by two iron plates *αα*, *εε*, under which it muſt run in the ſaid groove, ſo as to be ſlipped out from under it, and laid by, when the machine is not uſed; when alſo the piece at the other end may be unſcrewed and laid up: The long ſquares upon one end of the block, *viz.* 5, 6, 7, 8, Fig. 22. are two iron plates to be faſtened, where the knife,

knife, moving in a fit cavity, is to cut the bruiſed ſtuff between them; and of theſe plates, that, which lies next the end, is to be laid a little lower, the block being there pared accordingly, that ſo the ſtuff may fall off from the end of the machine the quicker, as the left hand ſupplies the bruiſed materials, whilſt the right hand does cut them: Let the hollow place, where the knife cuts, be as near as poſſible, only large enough for the knife to eaſily fall and riſe; and let the block be hollowed under the cutting hole, and ſloped off at that end, for the ſtuff to fall off as it is cut by the knife.

Microſcopical Obſervations; *by M.* Leewenhoeck. Phil. Tranſ. N° 106. p. 121.

THE ſmall red globules in the blood, are heavier than the cryſtalline liquor in which they ſwim; becauſe, ſoon after bleeding, theſe globules gradually ſubſide to the bottom, and conſiſting of ſoft fluid particles lying on each other, they unite cloſe together, and become dark red or blackiſh. M. *Leewenhoek* ſuppoſes the globules of the blood to be 25000 ſmaller than a grain of ſand: He obſerved ſeveral bones to conſiſt of tranſparent globules; and he is of opinion, that all things which appear white, are made up of tranſparent particles lying upon each other; as ſnow, white paper, linnen, white ſtones, white wood, ſcum, beaten glaſs, beaten roſin, ſugar, ſalt, *&c.*

The *Cuticula*, or ſcarf-ſkin, according to M. *Leewenhoeck*, conſiſts of round parts or ſmall ſcales; and he ſuppoſes its growth to be made in this manner, *viz.* that the coarſer and more conſiſtent parts of the humours continually emitted out of our bodies from between the ſcales, and not thro' pores, cleave to the body, and form the uppermoſt ſkin, while the finer particles evaporate.

A Dropſy *miſtaken for a big Belly.* Phil. Tranſ. N° 106. p. 131.

A Young woman of about 17 years of age, having her belly exceſſively ſwelled in 3 months time, was ſuſpected of incontinence; her complexion was florid, her body ſtrong, appetite good, and ſhe had all her evacuations regular, without head-ach, ſleepineſs, difficulty of breathing, thirſt, or any other hydropical ſymptoms; in 6 months, after conſulting phyſicians and mountebanks without any effect, her body was dried and bloodleſs, her breath ſhort, her temples fallen in, her noſe ſharp, her eyes hollow, her ſkin wan and ill-favoured, her

pulſe creeping, her appetite gone, her tongue dry, her voice weak, her evacuations ſparing, and all her ſtrength dejected; in a word, more reſembling a ſkeleton than a living body; but not inclining to undergo the operation of tapping, ſhe died in 3 months more: Upon opening her body, there ſoon appeared a great lake of water; whence at firſt it ſeemed to be a common *Aſcites*, a collection of water ſtagnating in the abdomen; neither liver, ſpleen, meſentery, pancreas, nor kidneys were to be ſeen; the *Peritonæum* was changed into a bag, by a ſeparation of its inner from its outer membrane; and thus it encloſed this whole quantity of water, that not a drop of it could eſcape into the cavity of the abdomen; and the compaſs of this bag formed by the two membranes, reached from the pubes to the diaphragm, and from the left region of the loins to the right; ſo that the nervous body of the *Peritonæum*, naturally as thin as a web of ſilk, being here thicker and cloſer than any ox-hide, was gradually expanded, like to the womb in gravidation: After removing this bag, the *Viſcera* came to view, which were neither gravelly, tartareous, nor chalky, as they often are in hydropical bodies, but only decayed and diſcoloured; which decay, by the timely uſe of an inciſion, might have been prevented.

The Order of the Bowels *inverted*; *by Dr.* Hen. Sampſon. Phil. Tranſ. N° 107. p. 146.

A Miniſter in *Yorkſhire* was troubled with a cough and other ſymptoms; he took a journey to *London* for his cure; but he lived not a fortnight after he came up; in his illneſs he drank a great deal of brandy, which haſtened his death: His limbs were obſerved to be extremely macerated; his belly was ſwelled, with ſome inequalities, eſpecially in the tract of the right muſcles, out of which a conſiderable quantity of water was taken; his guts were inflamed and extended with wind; his gall very viſcid; his lungs inflamed, and beſet with ſeveral glandules; but what was moſt of all ſurpriſing, was the inverted order of his bowels; his liver, which was very large, lay in the left *Hypochrondrium*, and his ſpleen in the right; the cone, or apex of his heart was on the right ſide, and accordingly the larger and thinner ventricle on the left, and the thick one on the right; the great artery deſcended on the right ſide, and the *Vena Cava* aſcended by the liver on the left; the *Oeſophagus*, or gullet, deſcended to the ſtomach on the right ſide, which made the *Pylorus*, or firſt orifice of the ſtomach, and entrance

entrance of the *Pancreas* to be on the left, and the firſt flexure of the ſmall guts to be towards the right; ſo that the beginning of the *Colon* with its *Apendicula*, lay at the *Os Ileon*, and the *Flexura Sigmoidæa* towards the right.

This perſon was never obſerved, in his life-time, to have any diſtemper, which might diſcover this inverted ſituation of his bowels; nor had it any influence on his illneſs or death; his left ſide was not more prominent than the other; neither was he left-handed; nor had he any weakneſs on his left ſide.

The Helmontian Laudanum; *by Mr.* Boyle. Phil. Tranſ. N° 107. p. 147.

THERE are two ſorts of the *Helmontian Laudanum*, the one by the elder *Helmont*, the other by the younger; the former was a great ſecret communicated by an expert chymiſt to Mr. *Boyle*, which he had not leave to publiſh; in ſome time after, he obtained of the younger *Van Helmont* ſome directions about the *Laudanum* he uſed, together with his permiſſion to communicate it to the publick, which, tho' differing from his father's, yet he himſelf ſeemed to think it not inferior to it, and to be more eaſily prepared.

Take of opium $\frac{1}{4}$ pound, 4 pounds of juice of quinces at leaſt; cut the opium into thin ſlices, and then mince it, and put it into the liquor made lukewarm, and mix it well, and let it ferment with a moderate heat for 8 or 10 days, rather more than fewer; then filtrate it, and infuſing in it of cinnamon, nutmeg, and cloves, of each an ounce, or 1 $\frac{1}{2}$ ounce; let them ſtand 3 or 4 days more, or for the ſpace of a full week, it will be the better; then filtrate the liquor once more, and letting it boil a turn or two after the ſpices are put in; then evaporate the ſuperfluous water to the conſiſtence of an extract, or to what other conſiſtence you pleaſe; laſtly, incorporate very well with it two ounces of the beſt ſaffron, reduced to fine powder; or as much extract, as can be obtained from that quantity of ſaffron: According to the conſiſtence you make it of, it may be either made up into a maſs of pills, or kept in a liquid form; and in this latter caſe, the evaporation muſt be more ſparing; that after the putting in of the ſaffron, or its extract, it may not be too thick; in this form, the doſe may be from 5 or 6 drops to 10 or fewer, according to circumſtances, and of the pills, a ſomewhat leſs quantity is requiſite.

An Alcalizate *or* fixt Salt *not in any Subject, before the Action of the Fire upon it; and no sensible Difference between the* fixt *and* volatile Salts, *and* vinous Spirits; *by Dr.* Dan. Cox. Phil. Transf. N° 107. p. 150.

THE alcalizate or fixt salt of plants extracted from their ashes after incineration, or from calcined tartar, do not, according to Dr. *Cox*, either pre-exist in the vegetables before they are exposed to the action of the fire, or differ not considerably from each other, at least to sense: The former part of this position is thus made out.

1. He never found, that any vegetable, or indeed animal or mineral substance, did in the least disclose by its taste or effects that it contained any such salt: Many plants and roots slightly bruised, affect the eyes and nose after the manner of volatile salts; and many bite the tongue, and strike upon the palate; some herbs yield a copious volatile salt, immediately after they are urged by a considerable degree of heat; and many sorts of earth abound therewith; so that it is highly probable, that they often actually exist in vegetables, in the very same form, wherein they appear upon distillation from the herbs themselves, or from soot; and that acid salts do really exist in many plants, appears by their taste and effects; they may also be obtained without fire or any artificial analysis; as is evident in tartar, and the reputed essential salts of many plants, in verjuice, vinegar, and verdegrease, whose acidities may be concentred, and made to appear in a dry form: Now did alcali's exist in the plants before the analysis, especially so copiously as they sometimes appear afterwards, they would certainly betray themselves by some sensible property, or other sign of their presence.

2. If alcali's pre-existed in plants, probably animals, whose only food they are, would likewise abound therewith; whereas there is not the least sign thereof, either in blood, urine, bones, horns, &c. all which abound in volatile salts: Nor can it reasonably be pretended, that the ferment of the stomach and other parts, several digestions and repeated circulations have altered its property, and at length rendred it volatile; for alcali's seem to be of a very fixt nature, and not easily volatilized; and daily experience will evince, that the chyle does not in the least participate, either in taste, or any other property, with alcalizate salts; besides, herbs taken out of the *Omasus* of ruminating animals, without any further digestion

or preparation, yield a volatile ſalt, when fermented or putrefied in the open air.

3. Moſt vegetables, whether woods or herbs, if burnt while green, and with a ſmothering fire, yield ſalts, which are far enough from being alcalizate; being either neutral or acid, or to ſpeak more properly, tartareous; for, they almoſt reſemble purified tartar, and in diſtillation yield the very ſame ſubſtances; it is true that a few herbs as ſatureia, roſemary, *&c.* which abound with a volatile oil, if well dried, yield upon ſimple incineration an alcalizate ſalt; as alſo ſome dry woods; but that they are produced by the fire appears from unqueſtionable experiments.

4. By the moſt natural method of analyſing plants, as fermentation and putrefaction without any additaments, oil, an acid ſpirit, and volatile ſalt are copiouſly obtained, all which evidently pre-exiſted; but if the herbs are entirely putrefied, little or no alcali can be extracted from them, as alſo neither from rotten wood; the active ſalts by whoſe combination the alcali is produced, having been evaporated.

Next it remains to enquire, how the fire produces this alcali, whether by the changing of one ſingle pre-exiſting principle, or by enabling any one of them to change the other; or laſtly, whether it be effected by the union of two, or more active principles, which thereby become different from what they were before combination: And that alcali's do reſult from the combination or union of the ſaline and ſulphureous principle; but whether it be the volatile, or acid ſalt, which combines with the oil or ſulphur, is now to be enquired into; and the following conſiderations ſeem to decide in favour of the acids: Firſt, tartar, which is ſenſibly acid, and from which a volatile ſalt cannot by any commonly known method be ſeparated, becomes by bare calcination a ſtrong and perfect alcali; ſecondly, nitre, an undoubted acid, with a ſmall proportion of mineral or vegetable ſulphur, is converted into a genuine fiery alcali; thirdly, nitre, which is made by the affuſion of an acid ſpirit on an alcali, may be almoſt totally diſtilled into an acid ſpirit, there appearing not the leaſt ſign of a volatile ſalt, and ſcarce any of the alcali, out of which it was chiefly produced; but theſe are inconſiderable arguments compared with thoſe which neceſſitate one to believe, that it ariſes from the union of the volatile ſalt with the oleaginous or ſulphureous principle; for, 1. There ſeems to be a great contrariety between acids and alcali's, on mixture they heat and ferment, whatever the one diſſolves the other precipitates; whereas, were alcali's of a nature approaching to acids, they would more plainly unite without

out that violent ſtruggle, which uſually enſues: 2. Alcali's and volatile ſalts agree in moſt properties, excepting their different degrees of gravity; they are both diuretical and de-obſtruent; they both diſſolve ſulphureous bodies, and agree in their contrariety to acids; but mix together quietly without noiſe, heat, ebullition, or impairing each others virtues; and they are eaſily ſeparable, the ſame in quantity and quality they were before mixture: 3. The tartareous or eſſential ſalts of vegetables cannot become alcali's, till their acidity be expelled; during which operation, the volatile ſalts and oil uniting become more ponderous than the acid, which before was heavier than either of them a-part; ſo that ſuch a degree of fire as will wholly diſſipate the acid ſpirit, cannot ſublime the more ponderous alcali; not but that, contrary to what is commonly aſſerted, the moſt fixt alcali may be ſublimed to a great height without additaments, by an intenſe degree of heat; for, Dr. *Cox* frequently reduced a pound thereof to three or four ounces, and recovered a conſiderable quantity receiv'd in well contrived veſſels, ſome yards above the crucible, very little, if at all, altered from what it was immediately before it underwent this operation; and it is chiefly on this account that ſoot yields ſome ſmall quantity of an alcali; eſpecially that neareſt the hearth: 4. Alcali's may be divided into oil and volatile ſalt by natural and eaſy methods of procedure: That acid ſalts are not concerned in this new production appears firſt, from tartar, whoſe acidity is driven away in great quantities before it can become alcalizate; and a volatile ſalt may by ſeveral methods be ſeparated therefrom; ſecondly, from nitre, tho' in diſtillation it yields an acid ſpirit, yet it abounds alſo in volatile ſalts; and beſides, perhaps in the operation of the ſulphur on the acid ſalt, ſuppoſing it ſuch, there is a comminution of its parts, whereby that becomes a volatile ſalt which before was an acid, they only differing in magnitude.

That ſalts perfectly alcalized differ not from each other; for moſt vegetables burnt green or moiſt, and with a ſmothering fire, yield a kind of neutral ſalt, which may be called tartareous, and ſometimes not improperly, eſſential, many of them retaining the vomitive, purgative, &c. qualities of the plants themſelves; now, whether it be ſome ſmall quantity of the eſſential oil, which mixt with the ſaline principle, renders it ſo variouſly medicinal, the eſſential oils of plants being evidently ſo many compendiums of the plants themſelves; or, whether theſe virtues are the reſult of the mixture of the ſeveral principles; certain it is, that after the oil is evaporated by an intenſe heat, or the craſis diſturbed

diſturbed by the avolation of ſome parts, and new combinations of thoſe that remain, all ſpecific qualities diſappear, and conſequently all other differences, than what purity and impurity, and ſeveral degrees of heat may occaſion, ſome being more hot and fiery than others; now, ſome ſalts are much more eaſily deprived of their acid and oily parts than others; and in ſome, on the contrary, the oil is of ſo fixt a nature, or rather ſo cloſely united with the other principles, that it muſt be a very intenſe heat which can disjoin them, and thereby reduce the ſalt to the common ſtandard, or aggregate of qualities, wherein all alcali's agree.

Tachenius pretends to demonſtrate, that there is a real difference between the alcali's of different plants, which he would prove by the various effects they have on a ſublimate diſſolved in common water; but this is eaſily reſolved by an obvious experiment; take what wood or plant you pleaſe and burn it green, the ſalt extracted from the aſhes will, according to the different degrees of fire, variouſly influence the mercurial ſolution; the ſeveral precipitates differing no leſs from each other, than when made with the ſalts of different plants: This is alſo very evident in tartar, which, the leſs and more gently it is calcined, the more ſalt it yields; and on the contrary, a much ſmaller proportion, if ſuddenly calcin'd with the higheſt degrees of heat; that prepared by the former method, is mild and gentle, in taſte reſembling acids a little; whereas the other, which has paſſed thro' the violence of the fire, has not the leaſt affinity therewith, and can as little be endured by the tongue as a live coal: Some pot-aſhes, being highly alcalizate, are fiery hot; others cold, watry, and nitrous to the palate, and no leſs weak in their effects than their taſte, of which ſoap-boilers, dyers and other mechanics are very ſenſible; all which is owing to the woods, when burnt, being either green or dry; to their abounding in oily, aqueous or acetous parts; as alſo to the ſeveral degrees of heat they are expoſed to: Such as make glaſs, and eſpecially the finer ſort, complain that they cannot with the the ſame quantities and proportions of ingredients always produce the ſame ſort of glaſs; which, not without reaſon, they aſcribe to the different aſhes.

The identity of all Volatile Salts *and vinous* Spirits; *by Dr.* Cox. Phil. Tranſ. N° 108. p. 169.

VOlatile ſalts abound in moſt vegetables, from which they may ſometimes be extracted by ſimple diſtillation, but uſually a previous fermentation is requiſite; this ſalt may alſo be obtained from ſoot, urine, blood, bones, and eſpecially from human

human ſculls; from ſeveral ſorts of horns, and from none in greater plenty than thoſe annually caſt by deer; from vipers very copiouſly; as alſo from ſeveral other animals; many minerals and foſſils contain volatile ſalt, vaſt quantities of ſal-armoniac being found in many parts of the eaſt, probably ſublimed into thoſe caverns, whence it is extracted, by the force of ſubterraneous fires; which conjecture is ſufficiently countenanced by the ſame ſubſtances being gathered near the mouths of volcano's, as *Ætna*, *Hecla* and *Veſuvius*; and in *England* near the mouths of ſeveral coal-mines, which have been accidentally fired; ſeveral ſorts of earths, clays and marle contain a great deal of volatile ſalts, which appear on diſtillation.

Vegetable oils extracted by means of common water are, as it were, a compendium of the plants that afford them, being eminently endued with moſt of thoſe qualities that diſcriminate vegetables themſelves; whereas their ſalts, either fixt or volatile, their phlegm and earth can boaſt of little which diſcovers their original, unleſs they retain ſome ſmall portion of their reſpective oils, by which they are diſtinguiſhed from each other; but being deprived thereof, they relapſe into their elementary ſimplicity; the ſame thing happens both in fixt and volatile ſalts, which are different ſo long as they retain any mixture of the oils and ſulphurs of their concretes, but freed therefrom, they all agree in one common eſſence: Take any volatile ſalt, either vegetable, animal, or mineral, put it into a very tall glaſs-body, or bolt-head, ſublime the ſalt in aſhes in *Balneo Mariæ*, in a lamp-furnace or other temperate heat, the gentler the better; repeat this operation twice or thrice; moſt of the oil will remain at the bottom, or adhere to the ſides of the veſſels, and the ſalts will not be eaſily diſtinguiſhed from each other; agreeing in moſt, if not in all their manifeſt qualities: But as the ſucceſs of this operation depends upon the nice regulating the fire, becauſe otherwiſe ſome of the ſubtiler oil or ſulphur will aſcend and infect the ſalts; the following method is more certain and eaſy: Pour on the volatile ſalt you would purify, a convenient quantity of well rectified ſpirits of common ſea-ſalt; when the ſalt is ſaturated, which is diſcovered by the ceaſing of the heat and ebullition, then with a gentle equal heat evaporate the phlegm; ſublime the remaining dry ſubſtance, which will become good ſal-armoniac, and this being pulverized and mixed with equal parts of a pure and well calcined alcalizate ſalt, or if you pour thereon a ſtrong lixivium, or ſolution of any perfect alcali, the alcalizate ſalt combining more cloſely with the acid than with the volatile, this

this latter will be ſublimed with a ſmall degree of heat; and it appears, either immediately, or on rectification, in the form of a dry ſubtile volatile ſalt, perfectly freed of oil or ſulphur; and by this method, all volatile ſalts, be the concretes that afforded them never ſo different, will be made to perfectly agree in ſome few common properties.

It now remains to ſhew the ſame identity or uniformity of nature and properties in all highly rectified vinous ſpirits, which has been diſcovered in ſalts both volatile and fixt: That vinous ſpirits are only, or at leaſt chiefly, the finer and more ſubtile oils of vegetables, broken by fermentation into leſſer particles, and leſs branched than thoſe that conſtitute the oils themſelves, will appear highly probable from the manner of their production, and ſeems demonſtrable by ſeveral obvious experiments; for the ſame quantity of vegetables diſtilled with water, and without any previous fermentation yield a plentiful oil, and little if any vinous ſpirits; but diſtilled after digeſting for a convenient time, and the addition of ſome proper ferment, afford a great deal of vinous ſpirits; and if fully fermented, little oil will appear: Alſo the ſame fermented herbs, after the extraction of their oil in the uſual manner, yield a far leſs proportion of vinous ſpirits, than when fermented before they were deprived of their oil: That portion of the oil, which is divided into leſſer particles by fermentation, does not affect the palate after ſuch different manners, nor make on it ſuch a variety of impreſſions, as thoſe that are cauſed by impulſes from the groſſer oleaginous particles: Now, if the ſmaller and more ſubtile matter, *viz.* the vinous ſpirits, urged by heat, do elevate along with themſelves ſome entire oily parts, or receive ſuch as are capable of being raiſed by the ſame degree of heat with themſelves; theſe mixtures will retain ſomewhat of the more remarkable differences in taſte and ſometimes odour, whereby the vegetables themſelves or their oils were diſcriminated; but by long and frequent digeſtions, or reiterated diſtillations, theſe groſs oleaginous particles are either ſubdivided, and thereby become vinous ſpirits; or that gentle equal degree of heat, which is ſufficient to elevate the more active volatile vinous ſpirits, cannot raiſe the more ſluggiſh oils; ſo that the reſults are pure ſimple homogeneous vinous ſpirits, which, whatever the concretes were, whence they were derived, tho' vaſtly differing from each other, as alſo their oils, out of which the vinous ſpirits were more immediately produced, yet the ſpirits themſelves, thus purified, are,

in outward appearance, ſimilar, and perhaps as perfectly ſimple and homogeneous as moſt ſubſtances in the univerſe.

This is further confirmed by a palpable converſion of vegetable oils into vinous ſpirits; pour on an ounce of ſome common vegetable eſſential oil, two or three pounds of vinous ſpirit perfectly dephlegmated, the greater the quantity is, the ſpeedier is the tranſmutation performed; the ſpirit will immediately, on a ſimple agitation, abſorb or diſſolve the oil, which by long digeſtion, or reiterated cohobations may be totally diveſted of all thoſe peculiar properties it enjoyed whilſt an oil, and become perfectly vinous, never to be ſeparated in a diſtinct form, or diſcriminated from it.

Here follow, two experiments that have ſome remote relation to the preceeding ſubject; Dr. *Cox* having procured a great quantity of fern-aſhes, the plant itſelf being between green and dry, when burnt, extracted their ſalt in the common manner with water; after evaporating moſt of the water he obtained ſeveral pounds of ſalt, the greateſt part of which being firſt dried, he expoſed the remainder to the air, that it might thereby become fluid, commonly called an oil *per Deliquium*; the reſt of the *Lixivium* which continued fluid, being filtrated whilſt warm, was of a very red colour, deeper than that of florid blood, or of moſt clarets, and exceeding ponderous; the colour argued that it abounded in ſulphureous or oily parts, and the weight, that it was highly ſaturated with the ſaline: Having put this ſtrong ſolution into a capacious glaſs, in five or ſix weeks it depoſited a large quantity of ſalt, which was at leaſt two inches thick over the bottom of the veſſel; the loweſt part of the ſalt was of a dark colour, as if ſome earth, dirt or dregs were mixed therewith; but the ſurface next the liquor was exceeding white; and there ſprung out of the whole maſs of ſalt, at ſmall diſtances from each other, about 40 branches, which abating the colour, did moſt exactly reſemble that ſort of fern, which is ſingle, like polypody, and not branched, ſending out ſeveral leaves on each ſide from one ſtem; their magnitudes were different, but the figures of all were the ſame, without the leaſt variation, only ſome emitted more leaves from the ſtem than others; which is alſo uſual in the natural fern.

The other experiment concerning volatile ſalts, ſucceeded in this manner; Dr. *Cox* mixed equal parts of ſal-armoniac and pot-aſhes, which latter had a very ſtrong ſulphureous ſmell, yet ſeemed to abound with ſalt, and that conſiderably alcali-

zed;

zed; putting the mixture into a tall glaſs-body, immediately upon its feeling the heat, a great deal of volatile ſalt was ſublimed, and in the glaſs-head he obſerved to his ſurpriſe a foreſt in perſpective of firs, pines, &c. ſo admirably delineated, as not to be excelled, if imitated, by the pencil of the greateſt maſter.

Microſcopical *Obſervations*; *by M.* Leewenhoeck. Phil. Tranſ. N° 108. p. 178.

M. *Leewenhoeck* took the eye of a cow, and piercing the *Cornea*, he found in the aqueous humour ſome few cryſtalline globules ſwiming; the dark brown colour he obſerved in this eye, conſiſted of dark grey globules.

Cutting aſunder with a razor the cryſtalline humour, he found it to conſiſt of orbicular ſcaly parts, lying on each other, which had their origin from the center, and were all made up of cryſtalline globules: In the vitreous humour he obſerved many more globules than in the aqueous; he found the *Cornea* to conſiſt of cryſtalline globules; the ſecond tunicle of the eye of black globules; and the third was exceeding thin and tender; and he obſerved it alſo made up of united globules: Having carefully viewed three optic nerves of different cows, he could diſcover no cavity in them; he only obſerved, that they were made up of many filaments, of a very ſoft ſubſtance, and that they only conſiſted of the corpuſcles of the brain united together, the threads being very ſoft and looſe; and theſe alſo were compoſed of conjoined globules, and wound about again with particles conſiſting of other tranſparent globules; but upon examining the *par vagum*, he obſerved not only one cavity, but two or three at once; and where the cavity was any thing large, it was lined about with films, to keep open the cavities and to prevent their being compreſſed by the ſurrounding parts.

A ſtrange kind of Bleeding *in a little* Child; *by M.* du Gard. Phil. Tranſ. N° 109. p. 193.

A Child, about a quarter of a year old, at *Littleſhal* in *Shropſhire*, was taken with a bleeding at the noſe and ears, and in the hinder part of the head, which laſted for three days, and afterwards the noſe and ears ceaſed bleeding, but ſtill blood like ſweat, came from the head: Three days before the death of the child, which happened the ſixth day after it began to bleed, the blood came more violently from its head, and ſtreamed out to ſome diſtance; it alſo bled on the ſhoul-

ders, and at the waſte, in ſuch quantities, that its linnen might be wrung; it bled alſo for three days at the toes, at the bend of its arms, at the joints of the fingers, and at the finger ends; and in ſuch quantities that in a quarter of an hour the mother had caught from the droppings of the fingers, almoſt as much as the hollow of her hand could hold: All the time of this bleeding, the child never cried very much, it only groaned; tho' about three weeks before, it had ſuch a violent fit of crying as was uncommon: After the child was dead, there appeared in the places, where the blood iſſued, ſmall holes like the pricks of a needle.

A further Account of the Zirchnitzer Sea; *by Dr.* Edw. Brown. Phil. Tranſ. N° 109. p. 194.

THIS lake is encompaſſed with high hills at ſome little diſtances, without any ſnow, tho' on other mountains in the country ſnow was obſerved in *June*; ſnow lies not ſo long on hills by the ſides of great lakes, as on thoſe at a diſtance: The holes for the water are generally ſtony, and not in ſoft or looſe earth; yet in one or two places, the earth has been known to ſink and fall in, particularly near a village called *Sea-dorf*: The great holes are the ſame every year, but poſſibly part of the water may ſometimes find or make new paſſages: When the water begins to retire, it is ſeen in theſe holes for a while, but afterwards it deſcends lower out of ſight: When the water is deſcended in *June* into thoſe holes, no water, at leaſt not any that is conſiderable remains in the lake: The fiſh are taken at theſe holes when the waters deſcend; for the prince of *Eckenberg*, who is lord of this lake, and the adjacent parts will not ſuffer them to be taken at any other time: Theſe holes are of different bigneſſes and figures; ſome perpendicular at the beginning, and then oblique; and others oblique at firſt; ſcarce two exactly alike: The water aſcends ſo plentifully, that it fills the lake in a ſhort time; ſome years the water fills all about *Nieder-dorf* and almoſt to *Zirchnitz*: The water that ſpouts from the holes ſeems ſomewhat clear in the air, but being ſpread about, it looks as formerly in the lake: The water is not always at the ſame height, but ſomewhat differing, in proportion to rain, ſnow, or drought: No river enters this lake, only ſome inconſiderable rivulets on the ſouth and eaſt-ſide; nor hath it any known outlet, but by the holes: The country about the lake is high: The ſnow falls not till after the lake is returned: This lake may probably communi-

cate

cate with ſome ſubterraneous great lake or magazine of water, which when full and running over, may diſcharge itſelf with violence; and when ſcanty of water, abſorb it again; the water returning by the ſame paſſage it came, and having no river running out of it, whereby it might diſembogue itſelf: In winter, it freezes like other lakes; ſo that the fiſh of this lake have a cloſer habitation than thoſe of any other; for they paſs ſome months under the earth, and a good part of the winter under ice: What they call the fiſher-ſtone, is a large ſtone on one of the elevated parts of the lake; which, how ſoon as it appears above water, is a ſign, that in a few days, the water will retire under ground; for after the filling of the lake in *September*, the water never falls ſo low, as to diſcover the fiſher-ſtone, till it begin to ſink under ground.

Animadverſions on the Theory *of* Light *and* Colours; *by M.* Franc. Linus. Phil. Tranſ. N° 110. p. 217.

M. *Linus* ſays, he never obſerved that difference between the length and breadth of the coloured *Spectrum* or image, when the ſky was clear, and free from clouds near the ſun; and that it only appeared ſo when the ſun either ſhone thro' a white cloud, or enlightened ſome ſuch clouds near it; and then it was no wonder the *Spectrum* ſhould be longer than it was broad; ſince the cloud or clouds ſo enlightened, were with reſpect to thoſe colours, a large ſun, making a far greater angle of interſection in the hole, than the true rays of the ſun; and therefore are able to enlighten the whole length of the priſm, and not ſome ſmall part thereof, as is enlightened thro' the little hole by the true ſun-beams; and this is alſo obſerved in the true ſun-beams, when they enlighten the whole priſm; for tho' in a clear ſky, the ſun's rays paſſing thro' the ſaid hole, never make a *Spectrum* longer than it is broad, becauſe they can then only occupy a ſmall part of the priſm; yet, if the hole be ſo much bigger, as to enlighten the whole priſm, you will preſently ſee the length of the *Spectrum* much exceed its breadth; which exceſs will be always ſo much the greater, as the length of the priſm exceeds its breadth: From whence, he concludes that the length of the *Spectrum* was not effected by the true ſun-beams, but by rays proceeding from ſome bright cloud; and conſequently that the theory of light founded on that experiment muſt fall to the ground.

Theſe animadverſions ſeem to require no other anſwer, than that the experiment, as it is repreſented, was tried in clear weather,

weather, and the prism placed close to the hole in the window, so that the light had no room to diverge; and the coloured image was made not in a parallel, but transverse position to the axis of the prism.

The Solar Numbers *corrected*; *by Mr.* Flamstead. Phil. Trans. N° 110. p. 220.

JAN. 1675. Mr. *Flamstead* found it necessary to make new solar numbers, because in the old he neglected to apply refractions in all the altitudes above 30°; wherein reason, and some little experience shewed him they were not insensible: He found Sig. *Cassini*'s observations, which he took from *Riccioli's Astronomia reformata*, much more accurate than *Tycho*'s, and therefore he sought out numbers that might answer them: He found it necessary to advance the *Apogæum* 44′, so that in the beginning of 1655, it might be in 7° 30′ of *Cancer*, and to make the greatest equation only 1°, 54′, 13″; whereby he found, the phænomena would answer much more accurately: But still he was uncertain, whether the refractions in *Cassini*'s tables were just measures or not; and he had no conveniencies for making trial; at last, he bethought himself of this expedient, which fully satisfied him; *viz.* he considered, that if some of these observations of the distances of *Venus* from the sun by day, and from the stars in the following or preceeding night, were skilfully examined, they might shew the true quantity of the equations of the sun's orb, or rather the difference of his mean and true motion: Mr. *Flamstead* turned over to *Tycho's Progymnasmata*, and pitched on two; the first made *Anno* 1582, *March* 5th, hor. 4, 42′, and hor. 7, 12′ p. m.; whereby he found the sun at hor. 4, 42′, was 94°, 47′ in antecedence of the *Lucida Calcis* of *Gemini*; the second made *Anno* 1582, *Sept.* 15, hor. 5, 15′, and hor 6, 55′ in the morning; from which, making allowance for the refractions in both, he found the sun at hor. 6, 55′ to be 74° 30′, in consequence of the lower head of *Gemini*; the difference of longitude of these two stars is 17°, 59′, and therefore now the sun, in consequence of the *Lucida Calcis* of *Gemini*, is 92°, 29′; so that the sun's apparent motion between the year 1582 *March* 5th, at hor. 4, 42′, and the year 1585, *Sept.* 15th, at hor. 6 55′ in the morning, besides the whole revolutions, was 187°, 16′; but the mean motion is 191° 2′ greater than the apparent by 3° 46′, which divided in proportion to the equation of the earth's motion, collected for those times from Mr. *Flam-*

stead's

ſtead's new tables, gives the greateſt equation of the orb 1°, 54′, 15″, agreeing in a ſurpriſing manner with that which he deduced from *Caſſini*'s correct meridional altitudes.

The ſun's motion, by the tables Mr. *Flamſteed* then uſed, grounded on this equation, is leſs than *Tycho*'s by 9′; that great equation made him fall into no ſmall errors, and put him on ſtrange ſhifts to hide and ſalve them; ſo that all his obſervations of the planets in their oppoſitions to the ſun muſt be corrected before we attempt to repreſent them in numbers; for his errors in the ſun's place, made him miſtake ſometimes five or ſix hours in the time of the oppoſition.

Obſervations *and* Experiments; *by Dr.* Liſter. Phil. Tranſ. N° 110. p. 221.

I. CErtain big pieces of crude alum-mines, as taken out of the rock, as alſo like pieces of the ordinary fire-ſtone, or marcaſite of the coal pits, called braſs-lumps, did ſhoot forth tufts of long and ſlender fibres or threads, ſome of them half an inch long, bent and curled like hair; and theſe tufts were in ſome meaſure tranſparent and cryſtalline, and did as often ſpring again, as they were ſtruck off; theſe fibres differed in taſte; the former being aluminous and agreeably pungent; the latter, ſtiptic and diſagreeable; the aluminous fibres, diſſolved in water raiſed a ſmall ebullition; whereas the vitriolic fibres diſſolved quietly; the former were generally ſmaller, and more opaque like ſnow; the latter larger, many of the fibres equalling an horſe-hair in thickneſs, and more cryſtalline: The water wherein the alum-fibres were diſſolved, gave no red tincture with galls, nor by all the means the doctor could deviſe to aſſiſt them; but the vitriolic did immediately give a purple tincture with galls: After laying pieces of the ſame marcaſite in a cellar, they were in a few months covered over with green copperas, which was theſe fibres diſſolved by the moiſt air, and again run together: Expoſing other pieces of the ſame vitriolic glebe in a window, where the ſun came, they were covered over with a white mealy matter, which was the fibres calcined by the ſun and warm air: He takes theſe fibrous and thread-like ſhootings of alum and vitriol to be very genuine and natural; and their angular ſhootings, after ſolution, into cubes and rhomboids, to be forced and accidental; ſalts of very different natures, both vegetable and foſſile, by a like proceſs in cryſtallizing, being obſerved to ſhoot into like figures.

II. Dr.

II. Dr. *Lifter* never obferved any rock or ftone, whether metallic or common, which hath not its peculiar fort of fpar or iris, both differing in colour and figure; and they are very common in blue lime-ftone rocks in *Yorkfhire*, out of which plenty of lead-ore is got: Thefe cryftals are moftly of a black water, like the black flint in chalk-hills; but there are fome of a purplifh or amethyftine colour; and fome again as clear as cryftal: They adhere to the feams of the rock, either betwixt bed and bed, or wherever there are crofs and oblique veins thro' the very fubftance of the bed: The fmaller the veins, the lefs the iris; you will find of them as fmall as wheat-corns, and others an hundred times bigger; they fhoot from both fides the feam, and mutually receive each other: They are thus figured, *viz.* there is a column of fix planes, very unequal as to breadth; the end adhering to the rock is always rugged, like a thing broken off; the other end of the column confifts of three five-angled planes, a very little raifed in the middle; thefe planes are alfo very unequal; be they never fo much ftraitened and compreffed in their fhootings; yet, both the column and top have the fame number of planes abovementioned; the places, where they are moft numerous, are *Rainsborough Scar* upon the *Ribble*, and a ftone-quarry near *Efhton Tarne* in *Craven*.

III. Dr. *Lifter* had from the ifle of *Sheppey* in the *Thames*, real fhark-teeth dug up there, and which could not be faid to be petrified; as to colour, they were firft of a vitriolic hue, but in a little time they became white, and of their natural colour: In the ftone-quarries in *Hinderskelf* park near *Malton*, he himfelf took out of the rock a fair *Gloffopetra*, with three points, of a black liver-colour, fmooth, and its edges not indented; its bafis, like a true tooth, was of a rugged fubftance, and carved a-round with imboffed work; it had certain eminent ridges or lines, like rays drawn from the bafis to each point.

IV. The ftones called *Dactili Idæi*, and *Lapides Judaici*, are brought over from beyond feas, and they are of different fhapes: There is plenty of them for kind, in the ftone-quarries at *Newton* near *Hemfley*, and at *Hellingly* by *Malton*; there is fome variety in their figure; but the moft common in thefe rocks refemble a date-ftone, being round, and an inch long, and fometimes longer; they are a little fwelled in the middle, and narrower towards each extremity; length-wife they are channelled, and knotted with fmall knots on the ridges, fet

in

in quincunx order; the inward ſubſtance is a white opaque ſpar, and breaks ſmooth like a flint; and is not at all hollow in the middle like the *Belemnites*.

V. Dr. *Liſter* obſerved, that certain foſſils, he had diſpoſed of into ſeveral drawers in a cabinet of *Barbado*'s cedar, had been thick covered over with a liquid roſin like turpentine; tho' after diligent ſearch, there appeared no manner of exudation in any part of the cabinet; and tho' ſeveral ſtones eſcaped, yet none of the *Hemetites* kind; and among 500 pieces of the *Aſtroites*, here and there one or two, and ſometimes more were thus covered over, and the reſt dry; he further obſerved, that ſtones of a ſoft and open grain, as well as thoſe of a hard and poliſhed ſurface, were affected in a like manner: It is certain, that the whole body of the turpentine of the cedar-wood was emitted into the air; and floating in it, was again condenſed into its own proper form upon theſe ſtones: This makes it more than probable, that odoriferous bodies emit and ſpend their very ſubſtance; thus camphire is ſaid, if not kept cloſe, to fly away entirely: Again, it is hence evident, that there is a great difference between the diſtillation of vegetable juices, and the emiſſion of *Effluvia*, or this natural diſtillation; the former really ſeparating and dividing the ſubſtance into different parts; but this latter extracting the whole entire and unchanged in its nature.

VI. The general and received opinion of *Botaniſts* concerning muſhrooms, is, that they are neither plants, roots, flowers, nor ſeeds; but the ſuperfluous humidities of the earth, of rotten woods, and other putrefactions; but Dr. *Liſter* thinks they are plants of their own kind, and owe their origin to ſomething more than chance; he inſtances in that ſpecies, called *Fungus poroſus craſſus magnus* J. B. The texture of the gills reſembles a paper prickt full of pin-holes; in *Auguſt* they are frequent under hedges, and in the middle of the moors in *Yorkſhire*; the gills of this muſhroom ſeem to be the very flower and ſeed of this plant; when it is ripe, the gills are eaſily ſeparable from the reſt of the head; each ſeed is diſtinct, and makes its impreſſion in the head of the muſhroom, juſt as the ſeeds of an artichoke in its bottom; the larger end of the ſeed is full and round, and they are diſpoſed in a ſpiral order, in the ſame manner as thoſe of an artichoke; the like ſeems to hold of all other muſhrooms, however differently figured: And if theſe ſeeds ſhould happen to miſcarry in ſowing, there is nothing extraordinary in that, ſince there are

whole genus's of plants, that flower and seed, and yet their seed was never known to produce plants of their kind, being naturally barren, and a volatile dust, as all the *Orchides* or bee-flowers are.

This mushroom, when fresh gathered, is of a yellow colour both outside and in; yet, if cut thro' the middle, it will in a moment change to a deep purple or blue, and stain linnen; a drop of the juice, leisurely squeezed out, will put on, holding it between your eye and the light, all the colours of the rainbow in the time of its fall, and fix in a purple.

VII. The several vitrifications of antimony are either opake or transparent; for the first kind, take of antimony one pound, flux it clear, and have in readiness an ounce or two of cawk-stone in a red-hot lump; put it into the crucible to the antimony; continue the flux a few minutes; cast it into a clean ungreased mortar, decanting the melted liquor from the cawk: This process gives above fifteen ounces of glass of antimony, resembling polished steel, and as bright as the most refined quicksilver: The cawk seems not diminished in its weight, but rather encreased; nor will it be brought to incorporate with the antimony, tho' fluxed in a strong blast: This cawk-stone seems to be much a-kin to the white milky mineral juices; and it is found by experiment, that the milky juice of lead-mines vitrifies the whole body of antimony in like manner as the cawk does; and besides these, no other mineral substance has any such effect upon antimony.

Cawk is a ponderous white stone, found in lead-mines; it will trace a white line like chalk, or the *Galactites*; but it is finer, and hath a smooth and shining grain, like spar, yet not in the least transparent.

An Eclipse *of the* Moon, January 1st, 167$\frac{4}{5}$; *observed at* London *and* Derby. Phil. Trans. N° 111. p. 237.

	h.	m.	h.	min.	sec.
			By *Flamstead*'s tables.		
AT *London*; the Beginning of the true Shadow	5	22	5	32	58
The Immersion	6	19	6	32	10
Emersion	7	58	8	7	50
End of the true Shadow	8	58	9	7	2

At *Derby*, which differs from *London* in longitude 5 m. Mr. *Flamstead* observed the beginning of the entrance of the true shadow 5 h. and 19 m. The *Penumbra* was seen at *London*

don to continue near half an hour, before it wholly quitted the body of the moon.

At *Paris*, M. *Bullialdus* ſaw at the royal obſervatory,

			By a Pendulu. Clock.	By the Philolaic Tables.
	d. m.	h. m. ſec.	h. m. ſec.	h. m. ſec
The beginning of true Shad. the altit. of *Capilla* being	52 26	5 32 29	5 32 50	5 44 27
Immerſion, altitude of *Capella*	62 8	6 33 3	6 35 46	6 46 24
Emerſion, altitude of the *Capella* of *Pollux*	43 46	8 9 30	8 8 0	8 24 24
End of the true Shadow, the altitude of *Sirius*	20 47	9 10 0	9 9 40	9 26 21

In ſome places the heavens anticipate the tables; in others, the tables anticipate the heavens.

An Account of Iceland; *by Dr.* Paulus Biornonius. Phil. Tranſ. N° 111. p. 238.

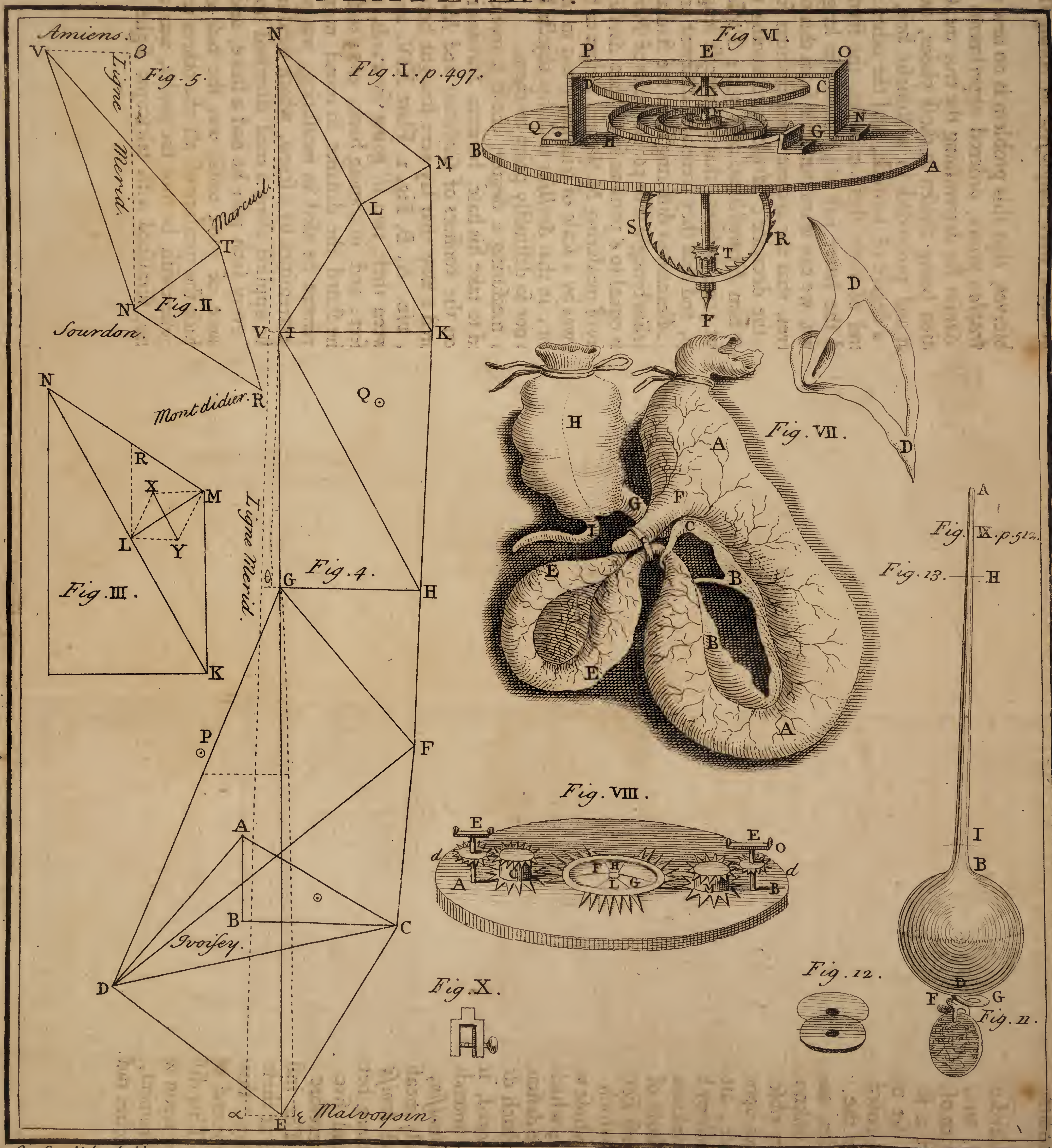
THE air of *Iceland* is very healthy all the year round: The diſeaſes the inhabitants are moſt ſubject to, are the cholic and leproſy: They have no phyſicians, only two or three ſurgeons, that furniſh ſome plaiſters for the dreſſing of wounds: Iron ruſts very ſoon in that air: The changes of the weather are uncertain; nor do they fall out according to the four ſeaſons of the year; ſometimes it ſnows, as well as hails, in the middle of ſummer; and the winds now and then blow very furiouſly at the ſame ſeaſon: The froſt penetrates at moſt four foot into the earth; ſpirits of wine and oil eſcape freezing, and much more quickſilver: Fiſh are preſerved from putrefaction, by burying them in the ſnow: Frozen bodies ſwell, and are changed both in taſte and colour: The figure of the ſnow is various, as is alſo its ſize: Hail is roundiſh; the largeſt is only of the bigneſs of hail-ſhot: Dr. *Biornonius* obſerved the *Ignis Lambens*, the *Draco Volans*, and frequently two mock-ſuns, with three rain-bows paſſing thro' them and the true ſun: They have no ſtated winds: The depth of the ſea is various, the greateſt about the coaſt of *Iceland* is 80 fathoms: The ſea-water, being ſtruck with oars in clear nights, ſhines like fire burſting out of a furnace: The tides obſerve the motion of the moon; the ſea ſwells about the moon's riſing and ſetting, and falls, when ſhe is to the ſouth and north; ordinarily the higheſt are not above ſixteen foot; except in autumn, when it is very

tempeſtuous, and then they riſe ſometimes to twenty foot; about the full and new-moon are the higheſt ſpring-tides, and loweſt ebbs: There are many lakes in this country, and moſt of them on high mountains, and ſtored with ſalmon; they have innumerable ſprings guſhing out of rocks; as alſo many hot-ſprings, whereof ſome are ſo hot, that in a quarter of an hour they will boil great pieces of beef; which is done in this manner; they hang the kettles with cold water over them, to prevent either the burning, or throwing up of the meat by the vehement ebullition of the hot waters; theſe waters harden and petrefy about the brims of the ſprings: The higheſt hills are not above a quarter of a *German* mile; there is a whole ridge of mountains running thro' the whole iſland: The inhabitants live only in the valleys, and towards the ſea-ſhore: There are other Vulcano's beſides *Hecla*, but all covered with ſnow: The declination of the load ſtone is to the north-weſt: The ſoil is generally clayey, in ſome places ſandy, but no where chalky: They uſe no tillage, all their commodities being imported, the chief of which are, barley, wheat, linnen and iron. They have great numbers of divers birds in ſummer; in winter, ravens, eagles, wild-duck, and ſwans: They are pretty well ſtored with horſes, oxen, cows, ſheep, dogs, and in ſome places with poultry; they have foxes in their mountains, and the *Greenland* ice brings along with it thoſe terrible gueſts, the bears: Their oxen and cows live in winter on hay; but their horſe and ſheep on the graſs under the ſnow, and the coralline moſs called *Muſcus marinus*: They have no minerals, as far as is known, only a great deal of brimſtone, of which they export yearly two ſhips lading: In 1642, *May* 13th, all the ſea, that beats on the promontories, was for two days ſo pellucid and ſhining, that ſhells, and the leaſt ſtones, could be ſeen at the bottom, where the ſea was forty fathoms deep.

An Account of the Meaſure of a Degree *of a great Circle of the* Earth; *by M.* Picard. Phil. Tranſ. N° 112. p. 261.

M. *Picard* had meaſured on a plain and ſtraight ground a ſpace of 5663 toiſes or fathoms, to ſerve for the firſt baſis to ſeveral triangles; by which he hath concluded the length of a meridian line equivalent to a degree of latitude, to be 57060 toiſes, that is 28 $\frac{1}{2}$ leagues, and 60 toiſes: What is remarkable in this, is that no body ever meaſured ſo great a baſis; the greateſt of former obſervations having only been of 1000 toiſes: And again very accurate inſtruments, and teleſcopical ſights, inſtead

PLATE XIV.



G. Smith delin. Hulett Sculp.

ſtead of common ones, were employed in taking the angles of poſition.

M. *Picard* obſerves, that this problem is no new thing; that *Almamon*, an *Arabian* prince, ordered experiments to be made in the plains of *Sanjar* for determining the true meaſure of a degree; and a ſtation being choſen in thoſe plains, two troops of horſemen ſet out and proceeded in a ſtraight line, till one of them had raiſed a degree of latitude, and the other had depreſſed it; at the end of both their marches, the former counted 56 $\frac{2}{3}$ miles, and the latter juſt 56; but as the length of theſe miles are unknown, we can learn but little from this obſervation: He further obſerves, that the ancient computations for a degree run always upon the decreaſe; *Ariſtotle* reckoning 1111 ſtadia to a degree; after him *Eratoſthenes* only 700; *Poſſidonius* only 666; *Ptolemy* but 500; beſides, that the preciſe length of theſe ſtadia is unknown, and that they were alſo different among themſelves; thoſe of *Alexandria* differing from the ſtadia of *Greece*: That at laſt *Fernelius* brought it to 56746 toiſes of *Paris* meaſure, each of which is equal to 6 pariſian feet; that *Snellius* made it 55021; whoſe way of meaſuring M. *Picard* judges to be the moſt artificial; which was by a ſcale of triangles; but in one thing he eſteems it deficient, in that *Snellius* took his objects by common ſights, which do not ſo diſtinctly point to them.

M. *Picard*, in meaſuring a degree, choſe a meridian, out of which he intended to take his baſe, between *Sourdon* in *Picardy*, and *Malvoiſin*, on the confines of *Gaſtinois* and *Hurepois*, and he actually meaſured a way that lay very ſtraight between *Villejuive* and *Ivoiſy*, *viz.* A, B, Fig. 1. Plate XIV. and he found the diſtance between theſe two, in going forwards, to be 5662 toiſes and five feet; and in coming back, 5663 toiſes and one foot; therefore he ſtated the diſtance in round numbers 5663 toiſes: The inſtrument he uſed in meaſuring, was pikes joined together at their extremities by a ſcrew, which meaſure was four toiſes long; this he applied along a cord ſtretched horizontally; and at the end of every ſuch pike he had a ſtake, and in all ten ſtakes: This diſtance of 5663 toiſes was the baſe of the firſt triangle, upon which the meaſure of all the others was formed: The inſtrument, wherewith he took the angles, was a quadrant of 38 inches radius, furniſhed with teleſcopic ſights.

In

In the first triangle, A B C Fig. 1. to find the sides A C, B C.

		°	′	″
Angles	C A B =	54	4	35
	A B C =	95	6	55
	A C B =	30	48	30

The side A B is 5663 toises of actual measure.
Hence A C is 11012 toises, 5 feet.
B C is 8954 toises

In the second triangle A D C, to find D C and A D.

		°	′	″
Angles	D A C =	77	25	50
	A D C =	55	0	10
	A C D =	47	34	0

	Toises	Feet
The side A C is	11012	5
Hence D C	13121	3
A D	9922	2

In the third triangle, D E C, to find D E, C E.

		°	′	″
Angles	D E C =	74	9	30
	D C E =	40	34	0
	C D E =	65	16	30

	Toises	Feet
The side D C is	13121	3
Hence D E	8870	3
C E	12389	3

In the fourth triangle D C F, to find D F.

		°	′	″
Angles	D C F =	113	47	40
	D F C =	33	40	0
	F D C =	32	32	20

	Toises	Feet
The side D C	13121	3
Hence D F	21658	0

In the fifth triangle D F G, to find D G, F G.

		°	′	″
Angles	D F G =	92	5	20
	D G F =	57	34	0
	G D F =	30	20	40

	Toises	Feet
Side D F	21658	0
Hence D G	25643	0
F G	12963	3

In

In the ſixth triangle GDE, to find GE.
The angle GDE = 128° 9′ 30″

		Toiſes	Feet
The Sides	DG	25643	0
	DE	8870	3
Hence	GE	31897	0

So then the line of diſtance between *Malvoiſin* and *Sourdon* being divided into three parts, *viz.* EG, GI, IN, the part EG is already found.

In the ſeventh triangle FGH, to find GH.

Angles	FGH = 39°	51′	0″
	FHG = 91	46	20
	HFG = 48	22	30

	Toiſes	Feet
The ſide FG	12963	3
Hence GH	9695	0

In the eighth triangle GHI, to find GI, IH.

GHI = 55°	58′	0″
GIH = 27	14	0
IGH = 96	48	0

	Toiſes
The ſide GH	9695
Hence GI	17557
HI	21037

Thus the ſecond part of the three, *viz.* GI, is found.
In the ninth triangle HIK, to find IK.

HIK = 65°	46′	0″
HKI = 80	59	40
KHI = 33	14	20

	Toiſes
The ſide HI	21043
Hence IK	11678

In the tenth triangle IKL, to find KL, IL.

LIK = 58°	31′	50″
IKL = 58	31	0

Toiſes

	Toises	Feet
The side IK	11683	0
Hence KL	11188	2
IL	11186	4

In the eleventh triangle KLM, to find LM.

Angles { KLM =	28°	52′	30″
KML =	63	31	0

	Toises	Feet
The side KL	11188	2
Hence LM	6036	2

In the twelfth triangle LMN, to find LN.

Angles { LMN =	60°	38′	0″
MNL =	29	28	20

	Toises	Feet
The side LM	6036	2
Hence LN	10691	0

In the thirteenth triangle ILN, to find NI

The sum of the angles IKL, KLM, MLN, taken from 360, there remains the angle ILN = 119° 32′ 40″

	Toises	Feet
The sides { LN	10691	0
IL	11186	4
Hence IN	18905	0

Thus, the line of distance EN, being divided into three unequal parts, EG, GI, IN, the measures of all three are found by this scale of triangles: *viz.* EG = 31897, GI = 1557, IN = 18905, which, added together make the length of EN, the line of distance between *Malvoisin* and *Sourdon*, *viz.* 68359: Now to continue this measure from *Sourdon* to *Amiens*, in order to verify *Fernelius*'s account, in Fig. 2. R is the steeple of St. *Peters* in *Montdidier*, T, a tree on the hill of *Mareuil*, U the lantern of *Notre Dame of Amiens*. To find the distance NU, look back on NLM, the last triangle of Fig. 1. and see how it is disposed in Fig. 3. where in the triangle LMR,

The angles { LMR =	58°	21′	50″
MRL =	68	52	30

	Toises	Feet
The side LM	6037	0
Hence DR	5510	3

In the triangle NRL,

The-

The angles $\begin{cases} NRL = 115^\circ & 1' & 30'' \\ RNL = 27 & 50 & 30 \end{cases}$

	Toiſes	Feet
The ſide L R	5510	3
Hence N R	7122	2

Go on to Fig. 2. in the triangle N R T.

The angles $\begin{cases} NTR = 72^\circ & 25' & 40'' \\ TNR = 67 & 21 & 40 \end{cases}$

	Toiſes	Feet
The ſide N R	7122	2
Hence N T	4822	4

Laſtly in the Triangle N T U.

The angles $\begin{cases} NTU = 83^\circ & 58' & 40'' \\ TNU = 70 & 34 & 30 \end{cases}$

	Toiſes	Feet
The ſide N T	4822	4

Hence N U 11161. 4. which was ſought, and to it adding the diſtance between *Malvoiſin* and *Sourdon*, *viz.* 68359, the whole will be the diſtance between *Malvoiſin* and *Amiens*, *viz.* 79520 toiſes and four feet. After meaſuring the particular diſtances between *Malvoiſin*, *Mareuil*, *Sourdon*, and *Amiens*, he proceeds to examine the poſition of each of theſe lines of diſtance in reſpect of the meridian, or to deduce the length of the meridian intercepted between the parallels of *Malvoiſin* and *Amiens*; which was thus done; *September* 1669, from the top of *Mareuil*, marked G, Fig. 4. Pl. XIV. from which one may ſee *Clermont* at I and *Malvoiſin* at E, he took the meridian, and with a quadrant the angles of declination from this meridian; and he found the angle E G ε Fig. 4. the declination of E G from the meridian weſtward 26; the angle G I θ, the declination of G I from the meridian eaſtward, 1° $9'$; the angle I N U, the declination of I N from the meridian eaſtward, 2° $9'$ $10''$; the angle U N β in Fig. 5. the declination of N U from the meridian weſtward 18° $55'$: So that in all theſe four triangles E G ε, G I θ, I N U, U N β, you have two angles known, for the angles at ε, θ, U, and β are right; and a ſide, *viz.* E G, G I, I N, N U; whence he concludes the length of the meridian G ε to be 31894 toiſes; of the meridian I θ, 17560 toiſes, three feet; of the meridian N U, 18893 toiſes, three feet; of the meridian N β, to be 10559 toiſes and three feet; and hence the length of the whole meridian $\alpha\beta$ between the parallels of *Malvoiſin* and *Amiens* to

be 78907 toiſes, three feet: Tho' theſe lines which make up the meridian be not in ſtrictneſs a curve, but in reality the ſide of a polygon circumſcribed about the circumference of the earth; yet the difference between thoſe lines and a true curve is only three foot every degree, which may be neglected: The length of the meridian between *Malvoiſin* and *Amiens* being thus ſtated, the next thing is to compare that diſtance with minutes and ſeconds in the heavens; and this he did with an inſtrument, whoſe limb was an arch of $\frac{1}{20}$ of a circle of 10 foot radius; and he pitched on the knee of *Caſſiopeia*, from which to meaſure the minutes and ſeconds of a degree in the heavens; in the next place, he aſſigns the number of toiſes or fathoms anſwering to a degree of the earth's circumference; as for inſtance, the difference of latitude between *Malvoiſin* and *Sourdon* is found by obſervation to be $1^\circ\ 11'\ 57''$; between *Malvoiſin* and *Amiens*, $1^\circ\ 22'\ 55$. Now the meridian diſtance between *Malvoiſin* and *Sourdon*, calculated from meaſures taken upon earth, was 60430 toiſes three feet; whence it is concluded, that 57064 toiſes and three feet, or in round numbers 57060 toiſes are equal to a degree: Hence the circumference of the earth is 20541600 toiſes; its diameter 6538594.

Exact portable Watches; *by M.* Huygens. Phil. Tranſ. N° 112. p. 272.

THE watches of this invention, being made ſmall, will ſerve for very exact pocket-watches, and when made larger, will be uſeful in finding the longitudes both by ſea and land; becauſe their movement is regulated by a principle of equality, as that of pendulums in a cycloid, and that no kind of carriage ſhall be able to ſtop them: The ſecret of the invention conſiſts in a ſpiral ſpring, faſtened by its innermoſt end to the axis or arbor of a poiſed balance, bigger and heavier than is uſual, which turns upon its pivots; and by its other end to a piece that is faſtened to the watch-plate; which ſpring, when the balance wheel is once ſet a-going, alternately ſhuts and opens its ſpires, and with the little aſſiſtance it hath from the watch-wheels, keeps up the motion of the balance-wheel; ſo that, tho' it turn more or leſs, the times of its reciprocations are always equal to each other. In Fig. 6. Plate XIV. the upper plate of the watch is A B; the circular balance-wheel C D, whoſe arbor is E F; the ſpring G H M turned ſpirally, is faſtened to the arbor of the balance-wheel in M, and to the piece that is fix'd to the watch-plate in G; all the ſpires or windings of the ſpring are free without

without touching any thing; N O P Q is the cock, in which one of the pivots of the balance-wheel turns; R S is one of the indented wheels of the watch, having a balancing motion, which is imparted thereto by the balance-wheel; and this wheel R S catches in the pinion T, which holds on the arbor of the balance, whose motion by this means is kept up as much as is necessary.

A Convolvulus *and an unusual Rupture of the* Mesentery; *by Dr.* Swammerdam. Phil. Transf. N° 112. p. 273. *Translated from the* Latin.

FIG. 7. Plate XIV. represents a convolvulus or *Iliac* passion arising from a rupture and circumvolution of the mesentery, constringing or straitning the intestines: A A is the ileum inflated in a surprising manner with wind and chyle, and inflamed: B B is the ruptured mesentery, forming a kind of fatal ligature for the intestines: C C the ligature itself almost like a tendril, which fastens the intestines: D D, the ligature delineated apart, together with its tendril, consisting of two turns. E E, the convolvulus of the intestine, or the part of the ileum strongly straitned and tending to a sphacelus; on which account there was no passage by stool; so that the contents of the small guts, were always thrown up by vomiting. F the part of the ileum extraordinarily extended by that violent and extraordinary trajection of the gut thro' the ligature D D, and resembling some blind gut: G, the extremity of the ileum, where it degenerates into the colon: H the colon a little contracted, and in its natural state: L, the cæcum.

The Astroites; *by Dr.* Lister. Phil. Transf. N° 112. p. 274.

THE astroites or star-stones are found at *Bugthorp* and *Leppington* at the foot of the *Yorkshire Woolds*; at the former place they are dug out of a certain blue clay on the banks of a small rivulet, between the town and the foot of the *Woolds*; there are plenty of them washed into the brook; but the fairest and most solid, are those got out of the clay: The substance of these stones, if broken, is like flint, of a dark shining polish; but much softer and easily corroded by an acid menstruum; vinegar indeed makes them creep; but a stronger spirit, as that of nitre, agitates them with violence; and no doubt, they will readily calcine, as the *Belemnites*, to a very strong and white lime: These stones are all fragments, as has been observed of the *Entrochi*; either one single joint, or two, three or more joints set

 together,

together, forming a five-sided column: Dr. *Lister* had not observed any piece much above one inch long, which consisted of 18 joints; and he saw one piece shorter than the former, with 25 joints: Every joint consists of 5 angles, which are either jetting out and sharp, and consequently the sides of the pieces made up of such joints, are deep channelled, or the angles are blunt and round, and the sides plain or very little hollowed: Where the joints are thin or deep, they are so equally throughout the whole piece; yet there are some, tho' very few pieces, which consist of joints of unequal thickness: Many of the thick-jointed pieces have certain joints somewhat broader, or a very little standing out at the angles; and thereby the joints are distinguished into certain conjunctions of two, three, or more joints; and these conjunctions are very observable in the thin jointed stones, and are marked out with a set of wyers: The thickest piece Dr. *Lister* observed, was not above 1 $\frac{1}{2}$ inch about, and those very rare too; from which size, to that of a small pin, he had all the intermediate proportions; and these small pieces, are as exactly shaped as the greatest; most pieces, if not all, of any considerable length, are not streight, but visibly bent: All the pieces of any sort, are much of an equal thickness, or but little tapering; yet one of the ends, by reason of the top-joint, is visibly the thickest: This top-joint hath five blunt angles, and is not hatched or engraven, or but very faintly, on the outside; every joint else of a piece, save the top-joint, is an *Intaglia*, and deeply engraven on both sides alike; and may accordingly serve for a seal; the middle of each angle is hollow, and the edges of the angles are thick furrowed; the terminations of these hatchings are the indented sutures, by which the joints are set together; the ridges of one joint being alternately let into the furrows of the other next it; the hatchings of the flat-sided pieces are in circular lines; but of the other two species, they are streight lines, or nearly so: In the very centre of the five angles is a small hole, conspicuous in most joints; and in the middle of each joint, betwixt angle and angle in the very suture, is another such like small pin-hole very apparent, if the stones be first well scoured: In the deep-jointed pieces, just under the top-joint above described, may be observed the traces of certain wyers rather than branches; and sometimes two, three, or more of the joints of the wyers yet adhering; these wyers are ever five in number, *viz.* one in the middle or hollow part betwixt angle and angle: It is no wonder that these wyers are knocked

knocked off, and but very rarely found adhering to the ſtones they belong to, being very ſmall and ſlender, of a round figure, and ſmooth-jointed, ſet together *per Harmoniam*, and not by indented ſutures: Nothing ſo much reſembles theſe wyers, as the *Antennæ* of lobſters: Laſtly, ſome of theſe wyers are knotted, and others of them fairly ſubdivided or branched.

Portable Watches; *by M.* Leibnitz. Phil. Tranſ. N° 113. p. 285.

M. *Leibnitz*'s principle for making exact portable watches, is altogether different from that of M. *Huygens*, the latter depending upon a phyſical obſervation, *viz.* an equal duration of unequal vibrations of pendulums or ſprings; the former grounded on a meer mechanical reflexion, which is ſufficiently eaſy, and whoſe demonſtration is manifeſt to our ſenſes, and which hath not been obſerved for want of the art of combination, whoſe uſe is more general than that of *Algebra*: For, M. *Leibnitz* conſidering with himſelf, that a ſpring bent to the ſame degree, will always unbend itſelf in the ſame time, providing it find the ſame freedom of unbending itſelf ſuddenly; and he inferred from thence, that there might be employed two ſuch; one of which ſhould play, whilſt the firſt mover of the watch did bend the other again; ſince it matters not in this way, whether it bend again more or leſs ſpeedily, ſo it bend, before the other have done unbending itſelf: Let A B, Fig. 8. Plate XIV. be one of the watch-plates; C and M two indented barrels, wherein the ſmall ſprings are incloſed; the teeth of the barrels catch thoſe of the pinions *d d*, which carry the balances *e e*; and the other teeth of the ſaid barrels are caught by thoſe of the interrupted wheel F G: Now, let us imagine that this wheel F G, being moved towards H F, by the force of the firſt mover of the watch, and turning the barrel C; bends the ſpring incloſed in it, and ſtops with the barrel, as ſoon as it has bent this ſpring; this piece, which ſerves to ſtop, is eaſy, and hath not been thought neceſſary to be marked here, to avoid embarraſſing the figure; but whilſt one indented part of the interrupted wheel F G, *viz.* F turns the barrel C; the empty part oppoſed thereunto, which is G, anſwers to the other barrel M, and gives liberty to the ſpring, it incloſes, to unbend itſelf: Thus, whilſt the movement of the watch bends the ſmall ſpring of the barrel C, in the ſame time the ſmall ſpring of the other barrel M, unbends of itſelf, except the ſpring ſhall have done bending a little ſooner than the ſpring M ſhall have unbent itſelf; ſo that the ſpring C being bent, and the

the wheel FG ſtopped; both of them continue in this poſture, till the ſpring M, when it is quite unbent, do, at the end of its motion, touch a piece which delivers it; and then the ſpring C unbends of itſelf in its turn; the teeth of the interrupted wheel, which continues its motion the ſame way as before, ſince it is delivered, not being any more able to hinder it therefrom, becauſe of the barrel C, do now meet with the empty part H of the ſaid wheel: But before it hath done unbending, the indented part L, being oppoſite to the void part H, that turns the barrel M, bends its ſpring again, and having done ſo, ſtops with it, whilſt the ſpring C, making an end of unbending itſelf, does the ſame office to the ſpring M it received from it: Which being well conſidered, it is manifeſt, that the ſame alternative motions will always continue; that the periods taken from the very moment that one ſpring begins to unbend, till the moment it once unbends itſelf again, will always be of equal duration, tho' the two ſmall ſprings be not equally ſtrong; that the balance of ſuch a watch will be double, and be charged more or leſs, and receive delay, by advancing or recoiling along the two arms, two equal weights, counter-balancing each other; that ſo the change of the ſituation may not at all prejudice the equality of the watch: For the reſt, we may in this kind of watches ſpare the fuſee, and conſequently the ſtring or chain: It is alſo eaſy to judge, that ſuch watches as theſe may be of a ſize ſufficiently ſmall; that they will make no greater beats than ordinary watches; that they will be as exact as pendulums, and ceaſe not to go whilſt they are a winding up: And tho' the motion of the watch-wheels may be altered by many accidents, ſuch as are, the inequality of the motion of the great ordinary ſpring, or firſt mover; the greater or leſſer friction of the wheels, as the oil grows thinner or thicker; the ruſt, the verdegreaſe, the play of the pieces, the inequality of the teeth, and the like; yet the periods of the ſmall ſprings will not be concerned in all, or any of them, providing the motion of the watch-wheels be always ſtronger than is neceſſary to bend them again.

It has been objected to this contrivance for finding the longitude; that the motion of ſhips would ſhake the ſprings, as well as the other parts; that ruſt would ſpoil them, ſince the ſalt moiſture of the ſea in long voyages ſpares not the very needles of compaſſes, tho' incloſed in boxes; that the changes of ſeaſons and climates will ſenſibly alter the ſprings; eſpecially the great heats or rains within the *Tropics*, which at length will ſomewhat untemper the ſteel; as is confirmed by the experiments of the illuſtrious academy of *Florence*, ſhewing how eaſily heat and cold

do

do change ſlender ſprings; beſides, that the air, more or leſs condenſed, will alſo more or leſs reſiſt the motion of the balance: To which may be added, that ſprings, by working, are weakened; and laſtly, that there will be always ſome little friction, which will make the ſeveral parts go more or leſs eaſily; and that even in length of time they will wear out.

It is anſwered, that all theſe defects, that proceed from the imperfection of the matter, may be ſurmounted by a general remedy; and that is, to uſe ſtrong ſprings, as are thoſe of croſs-bows; and they may be ſo large, and their reſtitution ſo ſpeedy by augmenting their number, that all the above mentioned defects will have no conſiderable proportion to this ſtrength; and the aggregate of their repetitions will not be ſenſible, till after a very long time; and it is eaſy to demonſtrate, that by augmenting the bigneſs of the engine, and the force of their ſtrong ſprings, the error may be made as ſmall as we will, providing the bounds of conveniency are not exceeded; and that we content ourſelves with an exactneſs ſufficient for their chief end, *viz.* the finding the longitude.

Improvements in Cornwal *with* Sea-Sand; *by Dr.* Cox. Phil. Tranſ. N° 113. p. 293.

THE ſea-ſand, made uſe of in the agriculture of *Cornwal*, is commonly at, or near the ſea-ſhore; which to diſtinguiſh from what is uſeleſs, it is to be underſtood, that the waſh of the ſea rolls, and tumbles, ſtones and ſhells, &c. over each other, whoſe grating makes this ſand: If the matter be ſhelfy, that is, the grating of ſtones, it is of ſmall value; but if it be conſiderably ſhelly, then it is good; and this ſhelly ſand is of three colours: About *Plymouth* and the ſouthern coaſt, the ſand is bluiſh, or grey like aſhes, which Dr. *Cox* conceives to be owing chiefly to the breaking of muſcles and oyſter-ſhells mixed therewith; weſtward, near the *Land's End*, the ſand is very white, and in *Scilly* glittering; which ſeems to proceed from the mouldring of moor-ſtones, or a kind of free-ſtone mingled with very white ſhells, called ſcallops: On the *North Sea* about *Padſtow*, and eaſtwards to *Lundy*, the ſand is rich, and of a brown-reddiſh-yellowiſh colour, and moſtly of the broken ſhells of cockles, which, he gueſſes to be of that colour there, from the waſh of the *Severn*, which falls very dirty into the *Severn-Sea*; and perhaps that accretion of the ſhells may be tinged thereby.

Beſides

Befides thefe colours of fands, there is alfo a difference in the bignefs of the grain, even in the fame harbour at *Plymouth*; in fome caves it is very fmall, in others larger grained; it is faid that the fmall is beft for the tenants, becaufe it works fooner and yields them a fpeedy return; the larger grained, better for the landlord and the land, becaufe it abides longer in the ground, and makes the pafture afterwards the better.

The beft fands as to colour, are, firft, the reddifh, next the blue, then the white; as to kinds, the moft fhelly, and the coralline are beft, and that which is taken up from under the falt-water, either by dredges, or left open by the ebbing of the tide; the blown fand is accounted of no ufe; and generally, if fand be well drained of the falt-water, fo that it may be more conveniently carried, it is better than that, which has lain long drying in the fun and wind, which takes off much of its virtue: Thefe ufeful fands are carried up by lighters as far up the country, as the tides will ferve to that purpofe, and there they are caft on fhore: When this fand is brought home, it is fpread on the ground intended for wheat, or ufually in the firft crop of four, whatever be the grain; for after four crops, the land is left for pafture for fix or feven years before it is tilled again; and the grafs will be fo good immediately after tillage, that it is commonly mowed the firft year; and is called mowing of gratten.

The *Cornifh* acre is 160 yards of 18 foot to the yard; on one of which, near 300 facks of fand are laid, according to the lefs diftance of the fand; fometimes 200, where the diftance is greater, *&c.* where a great deal of fand is ufed, the feed is much, and the ftraw little; but where lefs fand is ufed, there is much ftraw, and but little, and that hungry grain.

After the corn is off, the grafs becomes moftly a white clover, with fome purple, if the land be deeper; and this grafs of well-fanded ground, tho' but fhort, yet far exceeds, as to feeding, giving good creams, plenty of milk, and all other good purpofes, the longer grafs, where lefs fand is ufed; even garden herbs, and fruits in thofe places, are more and better in their kind; little or no fnow lies in thofe well-fanded places; there is a continual winter-fpring, an early harveft, a month or fix weeks before that within fix or feven miles of the place; and fuch a vaft difference of the air is found in fo fmall a diftance, that a man may in an afternoon travel, as it were, out of *Spain* to the *Orkneys*.

Of

Of a Storm *and* Lakes *in* Scotland; *by Sir* Geo. Mackenzy. Phil. Tranſ. N° 114. p. 307.

THE wind at *Tarbat*, *Dec.* 21 1674, was extraordinary; it broke down a ſtandard-ſtone, 12 foot high, five foot broad, and near two foot thick, that ſtood as an obeliſk near an old church; whole woods were rooted up, tho' they lay low; the wind blew from the north-weſt, and for a long time it had continued weſterly.

There is a little lake in *Stratherrick* on the Lord *Lovat's* lands, which never is quite frozen, even in the ſharpeſt froſts, before *February*; but after that time, by one night's froſt it will be frozen all over, and two nights will make the ice of a conſiderable thickneſs: Sir *George* was alſo told of two other lakes, much of the ſame nature with the preceeding; *viz. Loch Monar*, and another ſmall lake in *Strathglaſh* at *Glencanich*; this lake lies in a bottom formed by the tops of a very high hill; in the middle it never wants ice even in the hotteſt ſummer, tho' it thaws near the edges, and the ſun by reaſon of the reflexion from the hills be very hot, and tho' neighbouring lakes, that lie as high, have no ſuch appearance: It is alſo obſervable that the graſs about the borders of this lake retains a continual verdure, and fattens cattle more in a week, than any other graſs does in a fortnight.

The famous *Loch Neſs* never freezes; on the contrary, in the keeneſt froſts, the greater clouds of ſteams ariſe therefrom, which are ſoft and warm; and it is obſerved that roſemary continues to live in the gardens near that lake; tho' in other places that are warmer it dies, even where it is covered with ſtraw; and this muſt be owing to the warm ſteams of that lake.

In *Glenelg*, at a place called *Archigniglium*, there is a ſmall rivulet, which turns holly into a greeniſh ſtone, of which tinkers that work in braſs make both their moulds and melting-pots; and women their round whirls for ſpinning.

The Uſe of Air-bladders *in* Fiſhes. Phil. Tranſ. N° 114. p. 310.

THat liquids gravitate upon bodies immerſed in them, appears from this, that a bubble of air, riſing from the bottom, does dilate itſelf all the way to the top, which is owing to the decreaſe of the weight or preſſure of the incumbent water, the nearer it approaches the top; and this gave occaſion to the following conjecture; *viz.* that fiſhes by means of their bladder of

air can ſuſtain themſelves at any depth of water; for the air in that bladder is, like the bubble, more or leſs compreſſed, and takes up more or leſs ſpace, according to the depth the fiſh ſwims at; and conſequently, the body of the fiſh, part of whoſe bulk this bladder is, is greater or leſs, according to the ſeveral depths, and yet it retains the ſame weight; in hydroſtatics it being a rule, that a body, heavier than ſo much water equal thereto in bulk, will ſink; that a lighter will ſwim; and that a body of equal weight will remain in any part of the water: Now, by this rule, if the fiſh in the middle region of the water be of equal weight with a quantity of water equal thereto in bulk, the fiſh will remain there without any tendency either upwards or downwards; and if the fiſh be deeper in the water, the bulk of the fiſh becoming leſs by the compreſſion of the bladder, and yet retaining the ſame weight, it will ſink and remain at the bottom; and on the other hand, if the fiſh be higher than the middle of the water, the air dilating itſelf, and the bulk of the fiſh conſequently increaſing, but not its weight, the fiſh will mount upwards, and remain at the top of the water. Poſſibly the fiſh by ſome action or other can emit air out of this bladder, and afterwards out of its body, take in air again, and convey it to its bladder; which may be the action of ſome muſcle, by which the fiſh contracts this bladder; and perhaps the fiſh can by its ſides or ſome other defence keep off the preſſure of the water, and ſuffer the air to dilate itſelf; and in theſe caſes the fiſh may riſe or ſink from any part of the water without moving a fin; and to determine that theſe motions of the fiſh were performed by contracting or expanding itſelf, the honourable Mr. *Boyle* ſuggeſted the following experiment to be made; *viz.* Take a bolthead with a wide neck, and filling it almoſt full of water, put into it ſome live fiſh of a convenient ſize, as a roach, pearch, *&c.* and then draw out the neck of the bolt-head, as ſlender as you can, and fill that alſo almoſt with water; and if on the ſinking of the fiſh, you perceive the water at the ſlender top to ſubſide, you may infer, it contracts itſelf; and if, upon his riſing, the water be likewiſe raiſed, you may conclude, it dilates itſelf.

Obſervations on extraordinary Oranges *and* Lemons; *by* Petrus Natus. Phil. Tranſ. N° 114. p. 313.

THERE was a tree found in a grove near *Florence* of an orange-ſtock, which in its branches, leaves, flowers and fruit was triple-formed; ſome reſembling orange, ſome lemons or citron, and ſome again partaking of both forms in one; and par-

particularly, as to the fruit, ſome of this tree were mere oranges, ſome of them oblong like lemons, ſome round like common oranges, and ſome between both; ſome taſted like genuine oranges, others had an orange-rind, but a lemon-pulp; they were generally of a very ſtrong ſcent, and their rind of a very bitter taſte: The ſame tree bore alſo a kind of citron-lemon, but not ſo many as of the former kind; and it alſo produced a fruit, that was at once both citron, lemon and orange; and this fruit was ſo diverſified, that ſome of them were half citron-lemon, half orange; others were two thirds citron-lemon, and one part orange, others the contrary; and of all theſe, ſome were oblong, ſome round, ſome bunchy, ſome ſmooth and ſome rough; ſome ſmall, and others large; their pulp was ſo diſtinguiſhed, that where the orange-pulp ended, the lemon began, and on the contrary; again, the orange-pulp was narrower than that of the lemon; but this tenderer than that, and not ſo agreeable to the taſte, as the genuine ſingle fruit; and which was no leſs remarkable, they either had none, very few, or empty ſeeds. The firſt original of this tree was from inoculating an orange upon a citron-lemon-ſtock.

A New Eſſay-inſtrument; *by Mr.* Boyle. Phil. Tranſ. N° 115. p. 329.

MR. *Boyle* had made uſe of a little glaſs inſtrument, conſiſting of a bubble, and furniſhed with a long and ſlender ſtem to compare the ſpecific gravities of different liquors by its ſinking in them more or leſs; and afterwards he applied it to diſcover the ſpecific gravities of ſeveral appended ſolids, by its being more or leſs depreſſed by them in the ſame liquor; for it is plain from hydroſtatic principles, that any ſolid body heavier than water, loſes in the water as much of the weight it had in air, as water of equal bulk with the immerſed ſolid would weigh in the air; and conſequently, ſince gold, is by far the moſt ponderous metal, a piece of gold, and one of equal weight of copper, braſs or any other metal, being propoſed, the gold muſt be leſs in bulk than the copper or braſs; and if both of them be weighed in water, the gold muſt loſe in that liquor leſs of its former weight than the braſs or copper; becauſe the baſer metal as well as the gold, grows lighter by the weight of a bulk of water equal thereto; and the baſer metal being the more voluminous, the correſponding water muſt weigh more than that which in bulk is equal to the gold: Whence he concluded, that the floating inſtrument above-mentioned would be made to ſink

deeper by an ounce of gold, hanging at it under water, than by an ounce of braſs, or any other metal; which, on account of its greater bulk than gold, loſing more of its weight by the immerſion, muſt needs retain leſs, and ſo have leſs power to depreſs the inſtrument it was faſtened to; and this will hold of other metals that differ in ſpecific gravity.

This inſtrument may be of glaſs, copper, ſilver, or any other ſolid body that is, or may be made, fit to float on the water, with a guinea, *&c.* hanging at it, and of a texture cloſe enough to exclude the water: It conſiſts of three parts; *viz.* the ball, the ſtem, and that which holds the coin.

The ball or round part, B C D E, Fig. 9. Plate XIV. if of metal, conſiſts of two thin concave plates, exactly ſoldered together in the middle, and at the moſt diſtant points from the juncture, there ſhould be two oppoſite holes, one in each plate, for the two other parts of the inſtrument: This middle part, tho' for brevity ſake called the ball, ſhould not be exactly round, but of any ſhape that ſhall be found fitteſt to make the inſtrument keep its erect poſture ſteadily in the water; and it muſt be greater or ſmaller as the plates are thicker or thinner; but the general rule for its capacity is, that it ſhould contain as much air as may ſerve to keep the whole inſtrument, when loaded, from ſinking beneath the top of the ſtem.

The ſtem A B is to be ſoldered on to the ball at the uppermoſt of the two mentioned holes; it may either be hollow or ſolid; but it ſhould be made very ſlender, that the different depreſſions of the inſtrument in the water may be the more notable; and for the ſame reaſon, it ſhould not be too ſhort, eſpecially if it be applied to other uſes than the examining of guineas.

At the undermoſt of the two holes in the ball, is inſerted and ſoldered the ſcrew or ſtirrup F, ſee Fig. 10. which is a ſhort piece of braſs with a broad ſlit in it, capable of receiving the edge of the guinea, to be faſtened in it a turn or two of a ſcrew; the ſtirrup G, Fig. 11. is made of a piece of wire bent round, and ſtanding horizontally, that the guinea may be laid on it.

It would be convenient, that the undermoſt ſtem and the ſcrew be made by itſelf, that it may be at pleaſure thruſt on the ſtem, and taken off again; for, by this means, if the ball of the inſtrument be made large enough, you may have room to put on for ballaſt, as occaſion ſhall require, one, two, or three flat and round pieces of copper, lead, *&c.* Fig. 12, with each of them a hole in the middle, fitted to the ſize of the ſtem, ſo that they may be put on as near the lower part of the ball as

you

you think fit, and then the ſcrew may be thruſt on after them; not only to take hold of the coin, or metallic mixture to be examined, but to ſupport the thin plates.

To adjuſt this inſtrument for examining guineas, which are by far the moſt uſual gold coins; hang at the bottom of it, a piece of that coin you know to be genuine, and having carefully ſtopt the orifice of the ſtem, immerſe the inſtrument leiſurely and perpendicularly into a veſſel full of clean water, almoſt to the top of the ſtem, and then letting it alone; if it continue in the ſame ſtation and poſture, your work is done; if it emerge, you muſt add a little weight, either by putting into the ſtem, if it be hollow, ſome duſt-ſhot, filings of lead, or ſome other minute and heavy body; or elſe by putting on the ſhort-ſtem, that comes out beneath the ball, a flat, round, and perforated piece of lead, of weight ſufficient to enable the guinea, to depreſs the weight as low as it is deſired; but, if it ſink quite under water, to make it lighter, file or ſcrape off a little of the ballaſt-plate, and take out ſome of the weight, put into the cavity; this being done, a mark H, Fig. 13, is to be made juſt at the place, where the ſurface of the water touches the ſtem, and then taking out your inſtruments, ſubſtitute in the place of your guinea, a little round plate of braſs, of the ſame weight, or a grain or two heavier in the air; and putting the inſtrument into the water, as before, ſuffer it to ſettle, and make another mark I, at the interſection of the ſtem, and the horizontal ſurface of the water.

It may happen, that a falſifier of money may have the ſkill, by waſhing or otherwiſe, of taking off much of the quantity or ſubſtance of the guinea, without altering or impairing either the figure or ſtamp; and thus, the piece of coin will not be able to depreſs the inſtrument to the uſual mark, and thereby be judged counterfeit, when it is indeed but too light; but the balance will ſoon reſolve the doubt; for if the ſuſpected coin have in the air its due weight, it will argue, that its great lightneſs in water proceeds from its not being of the requiſite fineneſs; and if it want much of its due weight in the air, it is very probable, that it is waſhed.

A general way for finding what coins may, or may not be examined by this or that particular inſtrument propoſed; firſt, weigh the piece of gold or ſilver in the air, and afterwards in water, and ſubſtract the latter from the former; in the next place, weigh alſo in the air and water a piece of copper or braſs, if that be the likelieſt to be employed in counterfeiting the

the coin, and obſerve their difference; and the leſſer of theſe differences being ſubſtracted from the greater, the remainder will ſhew, how much the true piece of coin will outweigh the other in water; and conſequently, if ſo many grains, as this remainder amounts to, being added to the weight of the lighter metal, do make a ſufficiently manifeſt depreſſion of it below the mark, it would ſtay at without that addition, one may probably conclude, that the difference between a true and counterfeit piece of coin propoſed, will be diſcoverable by the inſtrument: But it may be expedient, for thoſe that have frequent occaſion to examine various ſorts of coin, to have a ſeveral inſtrument adjuſted for each of them.

With this inſtrument, pure tin may be certainly diſtinguiſhed from ſuch as is adulterated: For, as gold being the heavieſt of metals, cannot be allayed with any other that will not depreſs the inſtrument, leſs than gold can do; ſo tin, being the lighteſt of metals, cannot be mixed with any other, that will not ſink lower than unmixed tin, ſtill ſuppoſing the weight to be the ſame in the air.

In the ſame manner may pewter be compared and examined; for, having once obſerved how much the inſtrument is depreſſed by a piece of two, three, or four drams, or even an ounce weight of pewter, which is known to be good, and to contain ſuch a proportion of lead in reference to the tin; if you load the inſtrument with an equally heavy piece of any other maſs of pewter propoſed, and the inſtrument ſink deeper, it will be a ſign, that the former proportion of lead may be very probably argued to exceed in the mixture; this inſtrument may alſo aſſiſt in making a pretty tolerable eſtimate of the fineneſs of gold, and its different allays with ſilver, or, ſome other determinate metal: In order to which, the inſtrument may be fitted to ſink to the tip of the pipe, with ſome determinate weight of the fineſt gold, as of 24 carats; but it will be proper, that this metal in the air be ſome determinate weight, that is commodiouſly diviſible into many aliquot parts: Then you may make a mixture that contains a known proportion of the metal wherewith you allay the gold; as if it contain 19 or 15 parts of gold, and one of ſilver; and letting the inſtrument ſettle in the water, mark the place where the ſurface of the water cuts the ſtem or pipe; and then putting in another mixture, wherein the ſilver has a new and greater proportion to the gold; as if the former be an 18th or 14th part of the latter, you may obſerve, how much leſs this depreſſes the inſtru-

instrument; and thus you may proceed with as many mixtures, or degrees of allays as you think fit, or as many as may be conveniently diſtinguiſhed on the ſtem; always obſerving, that, whatever be the proportions of the two ingredients, the weight of the maſs in the air be juſt the ſame with that of the pure gold.

By the ſame method, the different allays of pure ſilver may be examined, on the mixing of any proportions of copper, or any other metal lighter in ſpecie than ſilver; and by the ſame way, with a ſlight variation, it will not be difficult to eſtimate, how much divers coins, whether of ſilver or gold, are more or leſs imbaſed by the known ignobler metal, mixed in the propoſed piece; theſe eſtimates, which may be made without much trouble, will come nearer the truth; not only than the eſtimates wont to be made by the touch-ſtone, but perhaps too than ſome of thoſe made with trouble and charges.

It may alſo be uſed, to examine other mixtures beſides allayed coins; and if the inſtrument be adjuſted to an ounce, ſuppoſe, of pure copper, it may aſſiſt in making an eſtimate of the allay of tin, or the quantity of it added oftentimes to copper, for making different ſorts of bell-metal, and of thoſe metallic *Specula*, whether plane or concave, called ſteel mirrours; as alſo of ſolders, conſiſting of certain proportions of ſilver and braſs, or copper; in all which, and divers others, the diſcovery of the proportion of the ingredients may, on ſome occaſions, be uſeful to tradeſmen, as well as agreeable to virtuoſi.

Of the Bladders *in* Fiſhes; *by Mr.* Ray. Phil. Tranſ. N° 115. p. 349.

THAT the uſe of the bladder in fiſhes is to ſuſtain them at any depth of water, appears firſt from this; that it has been obſerved, that if the ſwimming bladder of any fiſh be pricked or broken, it immediately ſinks to the bottom, and can neither ſupport, nor raiſe itſelf up in the water. 2. Flat fiſh, as ſoles, plaice, &c. which lie always groveling at the bottom, have no ſwimming bladders. 3. In moſt fiſhes there is a manifeſt channel from the gullet, or upper orifice of the ſtomach to the ſaid bladder, which doubtleſs ſerves for conveying air thither; and there is a valve in the bladder to hinder its egreſs; but Mr. *Willoughby* obſerved in ſturgeon, that preſſing the bladder, the ſtomach preſently ſwelled; ſo that it ſeems in that fiſh, the air paſſes freely both ways: Poſſibly the fiſh, while

while alive, may have a power of raising up this valve, and emitting air on occasion; which yet may be doubted of, since other animals have no such faculty of opening any valves, made to stop the reflux of fluids; but Mr. *Ray* thinks there is in the coat of this bladder a muscular power to contract it when the fish lists; for, in many fishes, it is very thick and opake, like the coat of an artery, as in all the cod-kind; in some, as the hake, it is internally covered with a red carnous substance, which seems to be muscular flesh; in others, it is forked at the top, and to each horn a muscle is affixed: Now the muscular force need not be great, being still assisted by the water, as the fish descends; the pressure of the water being much greater at the bottom than at the surface, as appears by the ascending bubble: But it may be objected to the assertion, *viz.* that the fish can by its sides, or some other defence, keep off the pressure of the water, and give the air leave to dilate itself; what occasion then for any air-bladder, since the cavity of the abdomen may serve the turn? to which it is answered, that this power of dilating the abdomen by the muscles may assist fishes to rise, whose natural place is toward the bottom; and the air compressed in the bladder, dilating itself as the fish ascends, facilitates the action of the muscles; but such fish as descend by contracting the bladder, upon the muscles ceasing to act, will rise again of their own accord, the internal air dilating itself: Besides the flat fish, all the cartilaginous kind want swimming bladders.

The END *of the* FIRST VOLUME.

THE

THE

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The INDEX.

Volatile

An EXPLICATION of ſome of the moſt material TERMS of ART in the Firſt Volume.

A

ABDOMEN is the Cavity of the lower Belly.

ACCELERATION is the Encreaſe of the Velocity of a moving Body.

ADIT is the Shaft or Entrance into the Mine.

ALCALI is either a Salt obtained from the Aſhes of Herbs or Minerals by making a Lye of them; or it is any Subſtance which, mixing with an Acid, makes an Ebullition with it.

AMALGAMA, is a Maſs of Mercury incorporated with any Metal.

ANTHELION is a Mock-ſun oppoſite to the true Sun.

AORTA, or great Artery, is that which ariſes immediately from the left Ventricle of the Heart and conveys the Blood throughout the Body.

APERTURE is in general any opening or hole; in Optics it ſignifies either the hole next the Object Glaſs of a Teleſcope or Microſcope thro' which the Light is tranſmitted to the Eye, or that part of the Object-glaſs itſelf, which covers the former.

APOGÆUM, that Point of the Orbit of a Planet, which is at the greateſt diſtance from the Earth.

ASSYMPTOTE, is a Line which ſtill approaches nearer and nearer to another, without ever meeting therewith, tho' indefinitely produced.

ATMOSPHERE is that whole Body of Air which ſurrounds our Earth.

AURICLES of the Heart, are its Ears, or two Muſcular Caps covering the Ventricles.

AXILLARY is ſomething belonging to the Arm-pit.

AZIMUTH, is an Arch of the Horizon intercepted between the Meridian of the Place and any Vertical.

B

BITUMEN, is a fat inflammable Matter, Pitch or Clay.

C

CACHEXY is an ill Habit or Diſpoſition of the Body.

CAROTIDS are two Arteries of the Neck which convey the Blood from the Aorta to the Brain.

CARTILAGINOUS is what belongs to a Cartilage or Griſtle.

CAVA, is the largeſt Vein in the Body terminating in the right Ventricle of the Heart, and conveying to it the Blood from all Parts of the Body; and it is divided into the aſcending, which ariſes from the lower Parts, and deſcending *Cava*, which comes from the upper Parts.

CHOROIDES is the inner and poſterior Coat of the Eye under the *Sclerotica*.

CHYLE is a whitiſh Juice into which the Food is converted in Digeſtion.

CONARIUM, is a ſmall Gland in the third Ventricle of the Brain, ſuppoſed by *Des Cartes* to be the Seat of the Soul.

CORNEA is the fore-part of the *Sclerotica*, surrounded by the White of the Eye.

CORPUS *Callosum* is the upper Part, or the covering of the two lateral Ventricles of the Brain.

CORPUSCLES are the ſmall Parts or Particles that conſtitute Natural Bodies.

CORTICAL Subſtance of the Brain is the exterior or outward Subſtance of the Brain.

CYON is a Graft, Shoot, or Sprig.

D

DIAPHRAGM *or Midrif* is a Muſcle ſeparating the Cavity of the Breaſt from the lower Belly.

DIASTOLE is that motion of the Heart and Arteries whereby thoſe Parts dilate and diſtend themſelves upon the flowing of the Blood into them.

DIURETIC is what promotes the diſcharge of Urine.

E

ECCENTRICITY is the Diſtance of the Centre of the Orbit of a Planet from the Sun.

ECLIPTIC is a great Circle of the Globe cutting the Equator obliquely.

EFFERVESCENCE denotes a great Ebullition or Boiling up of Liquors.

EMULGENT is a Name given the Arteries and Veins of the Kidneys.

EPHEMERIDES are Aſtronomical Tables ſhewing the Places of the Planets for every Day at Noon.

EPIGLOTTIS is the Cover or Lid of the *Laryux*, or upper part of the wind-pipe.

F

FOCUS, is a Point wherein Rays do meet after Reflexion or Refraction.

FOTUS is the ſame with Fomentation.

G

GLAND is a ſoft ſpungy Body ſerving to ſeparate ſome Humour from the Blood.

GLANDULA *Pinealis*, the ſame with *Conarium*, which ſee.

GLOTTIS, the Cleft or Chink in the *Larynx*.

H

HALO, a Circle of various Colours appearing round the heavenly Bodies.

HERNIA ſignifies a Rupture.

HORIZON is a great Circle of the Sphere, dividing the World into the upper and lower Hemiſpheres.

HYALOIDES is the vitreous Humour of the Eye.

HYPOCHONDRIUM is a Space on each Side of the upper Part of the lower Belly, under which the Liver and Spleen are lodged.

HYPOGASTRIUM is the lower Part of the Belly.

I

INTERCOSTAL ſignifies any Thing between the Ribs.

JUGULAR *Veins*, are Veins of the Neck, by which the Blood returns from the Head to the Heart.

L

LACTEALS, are ſlender Tubes, which convey the Chyle from the Inteſtines to the *Receptaculum Chyli*.

LARYNX, is the upper Part of the Wind-pipe, lying below the Root of the Tongue.

LIBRATION, is an apparent Irregularity in the Motion of the Moon, whereby ſhe ſeems to ſwing or ſhake about her Axis, ſometimes from Eaſt to Weſt, and ſometimes on the contrary.

LIGATURE, is a Band, Tie, Bandage or Fillet.

LIXIVIAL, is underſtood of Salts extracted by a *Lixivium* or Lye.

LOBES, are the Diviſions of the Lungs and Liver.

LOCUS *in Geometry*, is a Line by which an indeterminate Problem is ſolved.

LYMPH, is a thin tranſparent Humour ſeparated from the Blood in all Parts of the Body.

LYMPHATICS, are fine ſlender Veſſels ariſing from the Glands, which re-convey the Lymph to the Blood.

M

MEDULLA *Spinalis*, is the Marrow of the Back bone.

MEMBRANE, is a thin, white expanded Skin; formed of a Web of ſeveral Sorts of Fibres or Threads.

MENSTRUUM, is any Liquor that will diſſolve hard Bodies.

MESENTERY, is a membranous Part, placed in the Middle of the Inteſtines or Guts, and to which they are connected.

N

NARCOTIC is what benumbs and takes away the Senſe of Pain.

O

OPAKE is what tranſmits no Light, in Oppoſition to tranſparent.

PAN-

P

PANCREATIC, is what belongs to the Pancreas or Sweet-bread.

PARALLAX, is an Arch intercepted between the true and apparent Place of a Star; the true Place being that Point in the Heavens wherein the Star is ſeen from the Earth's Centre, and the apparent, that wherein it is ſeen from the Earth's Surface.

PELVIS *of the Kidneys*, is a Cavity in their concave Part, into which the Urine is conveyed from the Glands, and whence it paſſes thro' the Ureters into the Bladder.

PERICARDIUM, a Membrane or Bag which includes the Heart.

PHASES, are the Appearances, or the Quantities of the Illumination of the Planets.

PHÆNOMENON, is any Appearance or Effect in natural Things.

PIA *Mater*, is a fine Membrane, which immediately inveſts the Brain.

PLEURA, is a Membrane which lines the Cavity of the Breaſt.

PLICA *Polonica*, is a Diſeaſe of the Hair, wherein it is matted and glued together, and peculiar to *Poland*, whence the Name.

PYLORUS, is the lower Orifice of the Stomach, whereby it diſcharges itſelf into the Guts.

R

RECEPTACULUM *Chyli*, is a Reſervoir or Cavity near the left Kidney, into which the Lacteals diſcharge themſelves.

RETINA, is the innermoſt Coat of the Eye lying immediately under the *Choroides*, and ſuppoſed to be the Organ of Viſion.

RIMULA *Laryngis*, is the ſame with *Glottis*, which ſee.

S

SATELLITES, are Planets moving round other Planets.

SCLEROTICA, is one of the Coats or Membranes of the Eye, lying immediately under that Part called the White of the Eye.

SEROSITY, is a watry Liquor mixed with the Blood.

SERUM, is the thin tranſparent Part of the Blood.

STERNUM, is the Breaſt Bone ſituated forwards between the Ribs.

STYPTIC, is a Remedy that has the Virtue of ſtopping Blood, or of cloſing up a wounded Veſſel.

SUBCLAVIAN, ſignifies any Thing lying under the Channel Bones.

SUPPURATION, is the Action whereby Blood and other Humours are changed into Pus or Matter.

SUTURE, is a particular Kind of Articulation of the Bones, reſembling a Seam.

SYSTOLE, is the Contraction of the Heart and Arteries, whereby they diſcharge the Blood.

T

THORAX, is the Cheſt or Cavity of the Breaſt.

TROPICS, are ſmaller Circles of the Sphere equally diſtant from the Equator.

U

VENTRICLE ſignifies the Stomach, and is alſo particularly applied to the Cavities of the Heart and Brain.

VERTEBRÆ, are the Chain of Bones reaching from the Neck down the Back, called the Back-bone.

VESICLES, are little Bladders.

VISCERA, are the Bowels or Entrails.

ERRATA.

PAGE 16. *l*. 37. for *r* F^2 C^2. *r*. F^2 C^2 *p*. 63. *l*. 37. for Valve *r*. Plug. *p*. 89. *l*. 12. for Bilws's *r*. Bill's. *p*. 111. *l*. 5. for tho' *r*. and. *p*. 137. *l*. 35. for Logarithm. Technia *r*. Logarithmotechnia. *p*. 141. *l*. 3. for Groves *r*. Grooves. *p*. 153. dele laſt Line. *p*. 155. in all that Page for Epididymus *r*. Epididymis. *p*. 155. *l*. 37. for Current *r*. Currant. *p*. 237. *l*. 26. *r*. by the Help of Iron-ſtone, which is not Iron-Ore, but a Stone found thereabouts, of which the Liver-coloured is the beſt, of Kys, a Sort of Pyrites, and of Schlacken, a Scum, &c. *p*. 239. *l*. 9. for Humours *r*. Coats. *p*. 246. *l*. 8. for of the Weſt *r*. to the Weſt. *p*. 374. *l*. 33. for every *r*. very. *p*. 449. *l*. 31. for Flexion *r*. Reflexion. *p*. 457. *l*. 21. for, and terminated, *r*. which terminated. After *p*. 60. *r*. *p*. 61. inſtead of 53; and for *p*. 54, 55, 56, 57, 58, 59, 60, *r*. *p*. 62, 63, 64, 65, 66, 67. 68.